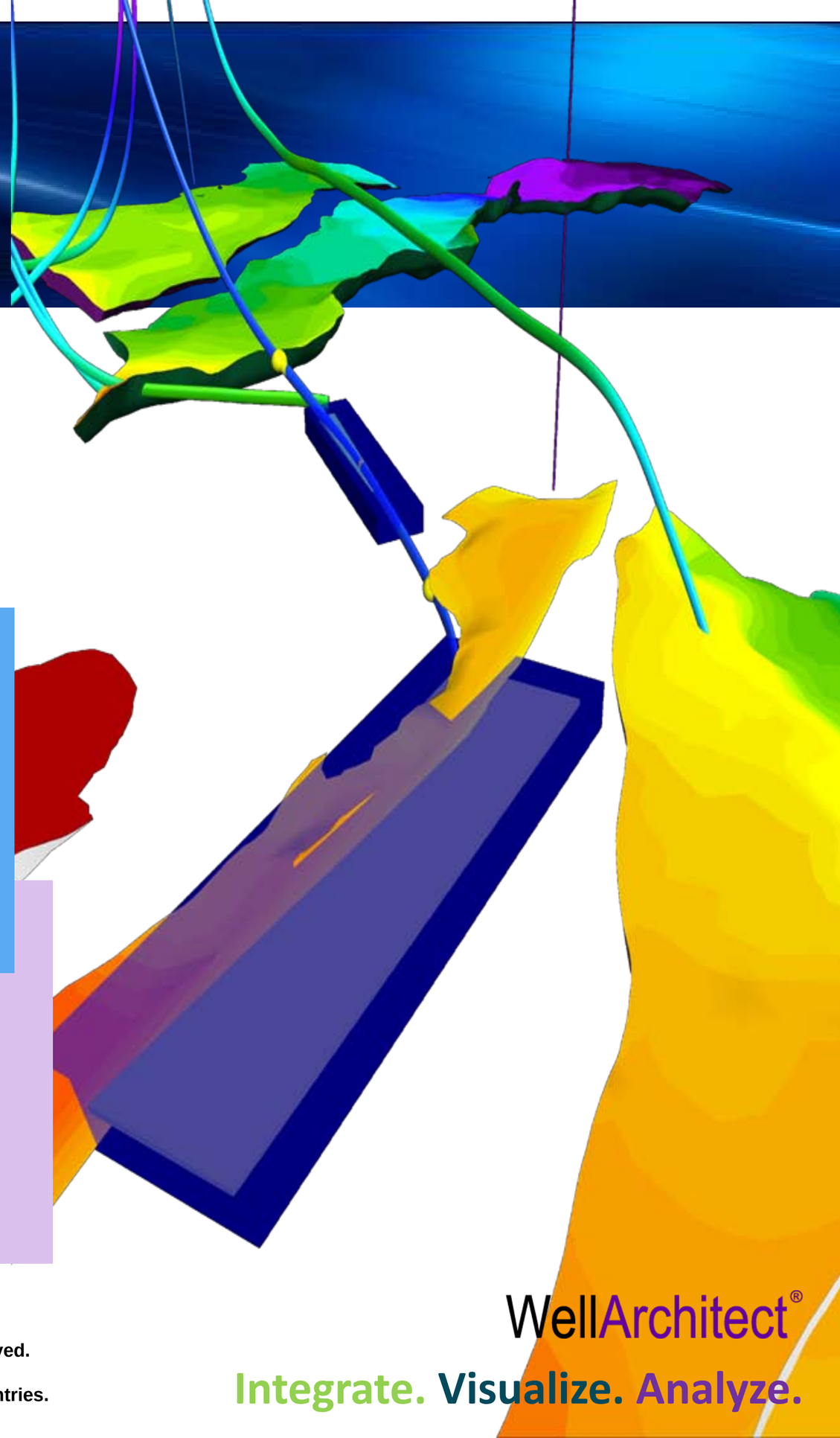
# 3D Representation of Clearance Scans



**Carol Eve Mann**
**WellArchitect Project Manager**
**Dynamic Graphics, Inc.**

ISCWSA

4 March, 2011

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WellArchitect®

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# The ISCWSA

From the ISCWSA website (www.iscwsa.org):

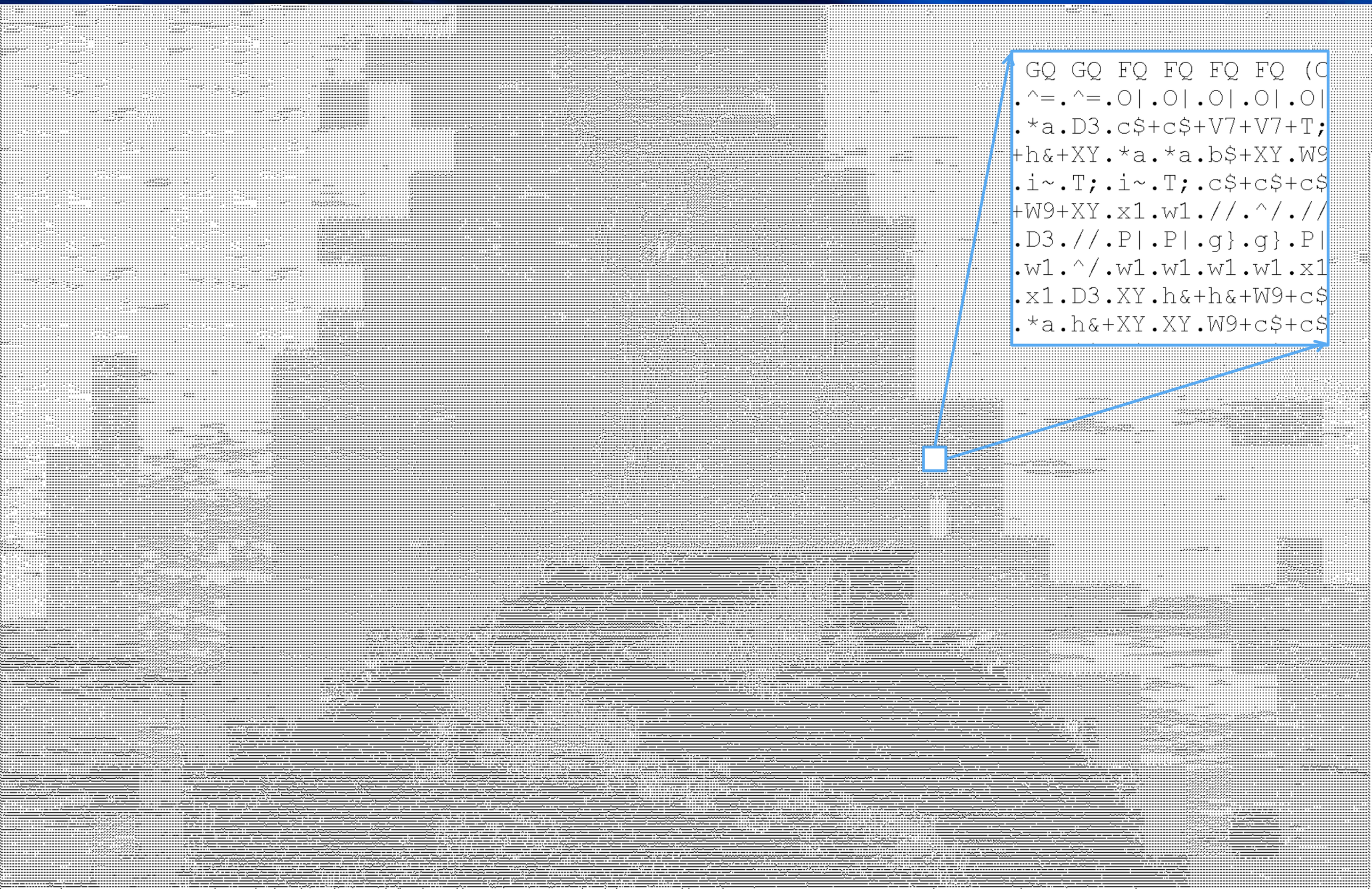
- “The … ISCWSA … is seeking to dispel the confusion and secrecy currently associated with wellbore surveying….”
- …. “is seeking to dispel the confusion and secrecy currently associated with”…***numbers***….

Much of the work we do is centered around numbers and how to make those numbers usable and understandable to a wider audience.

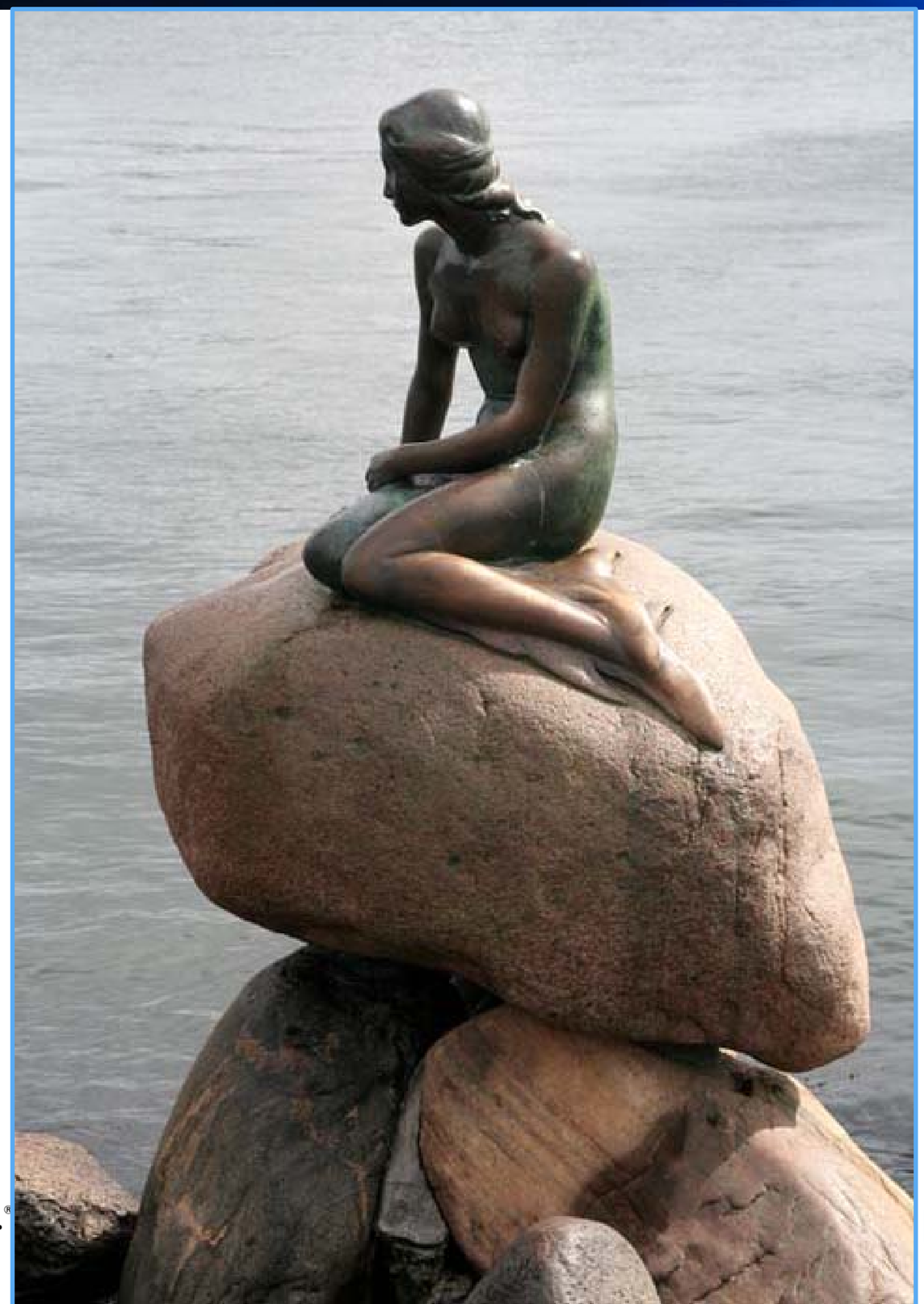
# An Example: Do you know what it is?

```
# Type: property scattered data
# Version: 8
# Description: Exported from tif2pdat.py
# Format: free
# Field: 1 x
# Field: 2 y
# Field: 3 z unknown
# Field: 4 symred integer
# Field: 5 symgreen integer
# Field: 6 symblue integer
# Units: unknown
# End:
1     720   1     190   195   199
2     720   1     189   194   198
3     720   1     187   192   196
4     720   1     186   191   195
5     720   1     185   190   194
6     720   1     185   190   194
7     720   1     186   191   195
8     720   1     187   192   196
9     720   1     186   191   195
10    720   1     187   192   196
11    720   1     188   193   197
12    720   1     188   193   197
13    720   1     189   194   198
14    720   1     188   193   197
15    720   1     188   193   197
16    720   1     187   192   196
17    720   1     182   187   191
```

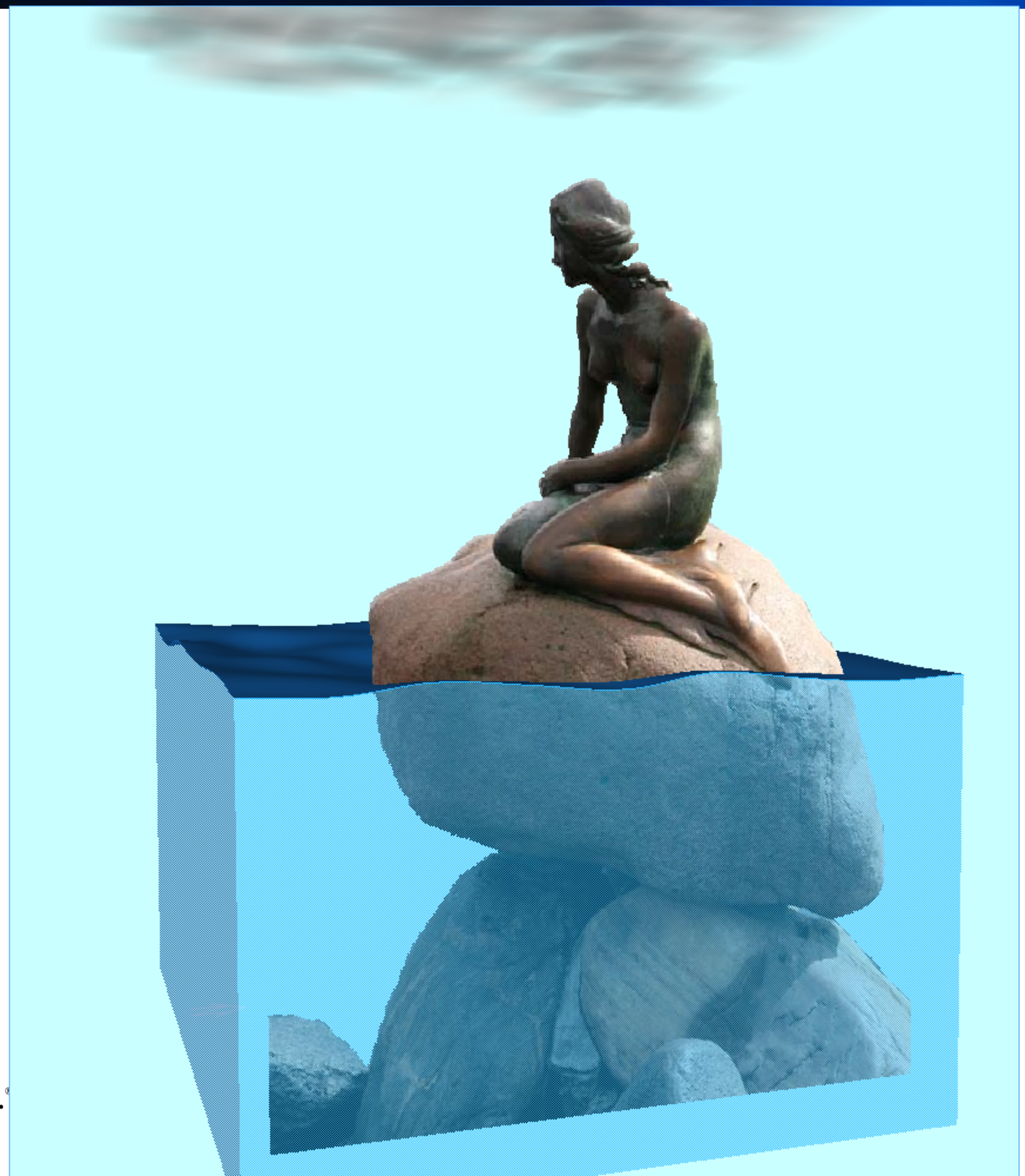
# An Example: Do you know what it is?



# An Example: Do you know what it is?



# But What Happens When We Look at 3D Data in 3D?



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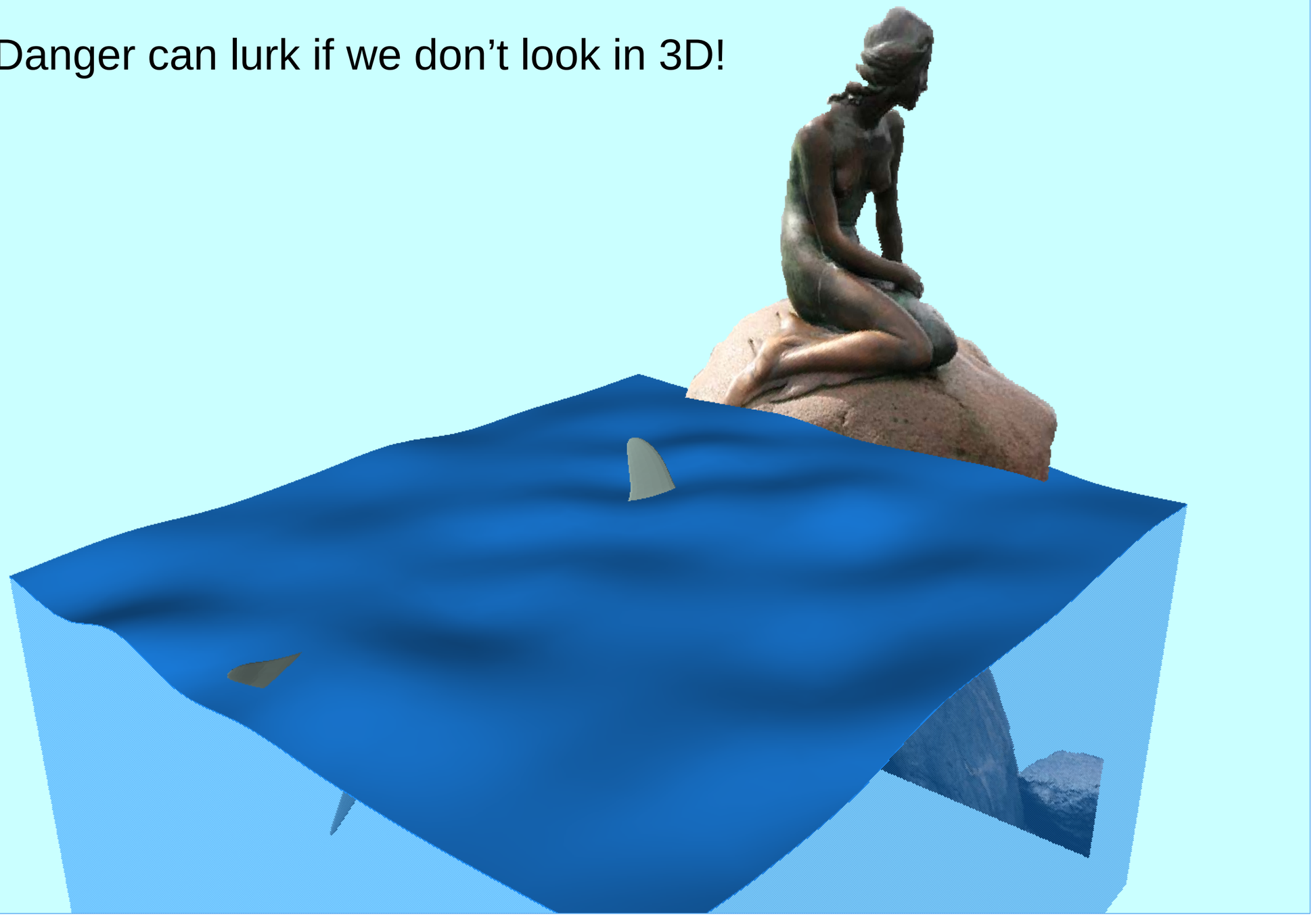
# But What Happens When We Look at 3D Data in 3D?

Danger can lurk if we don’t look in 3D!



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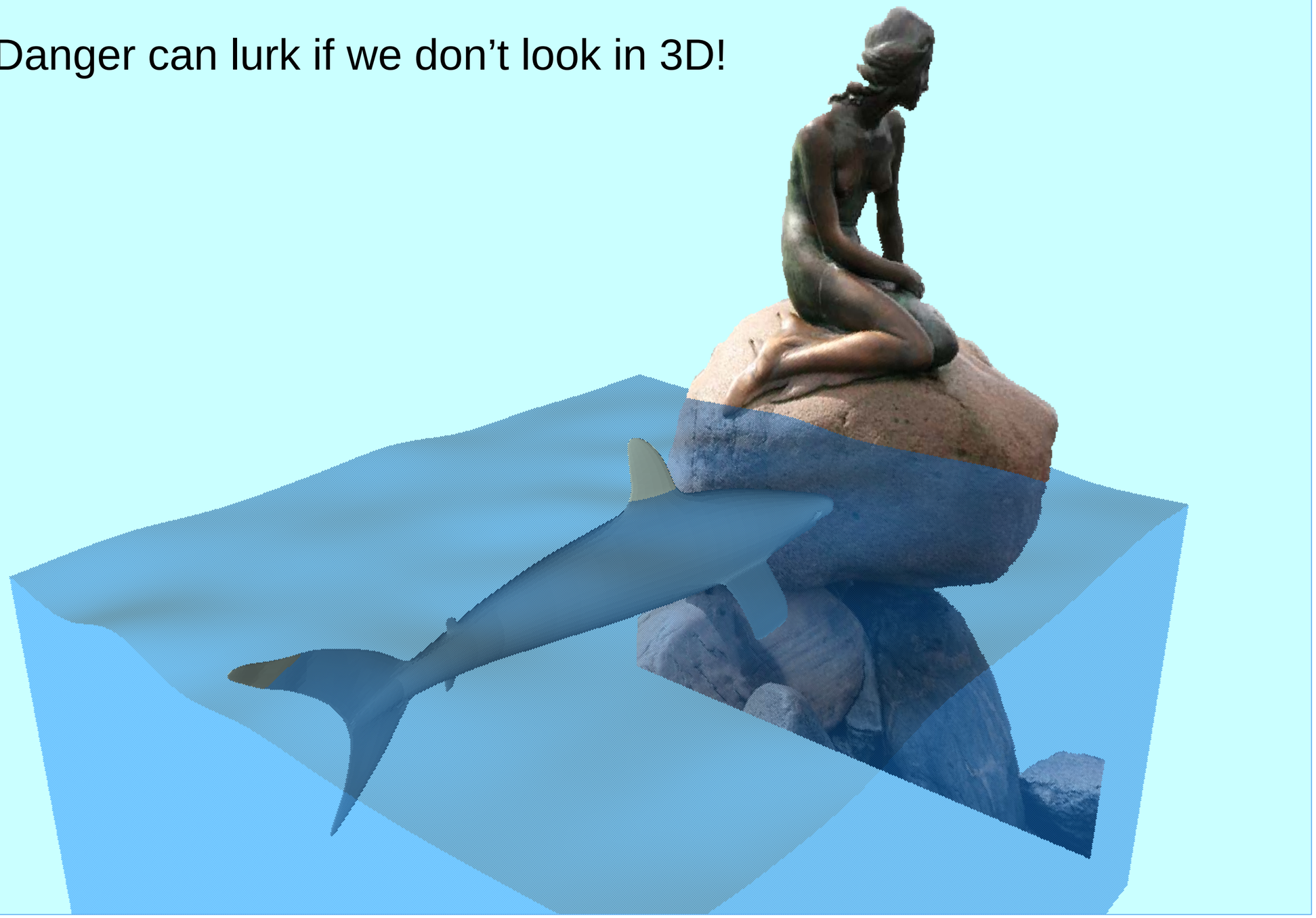
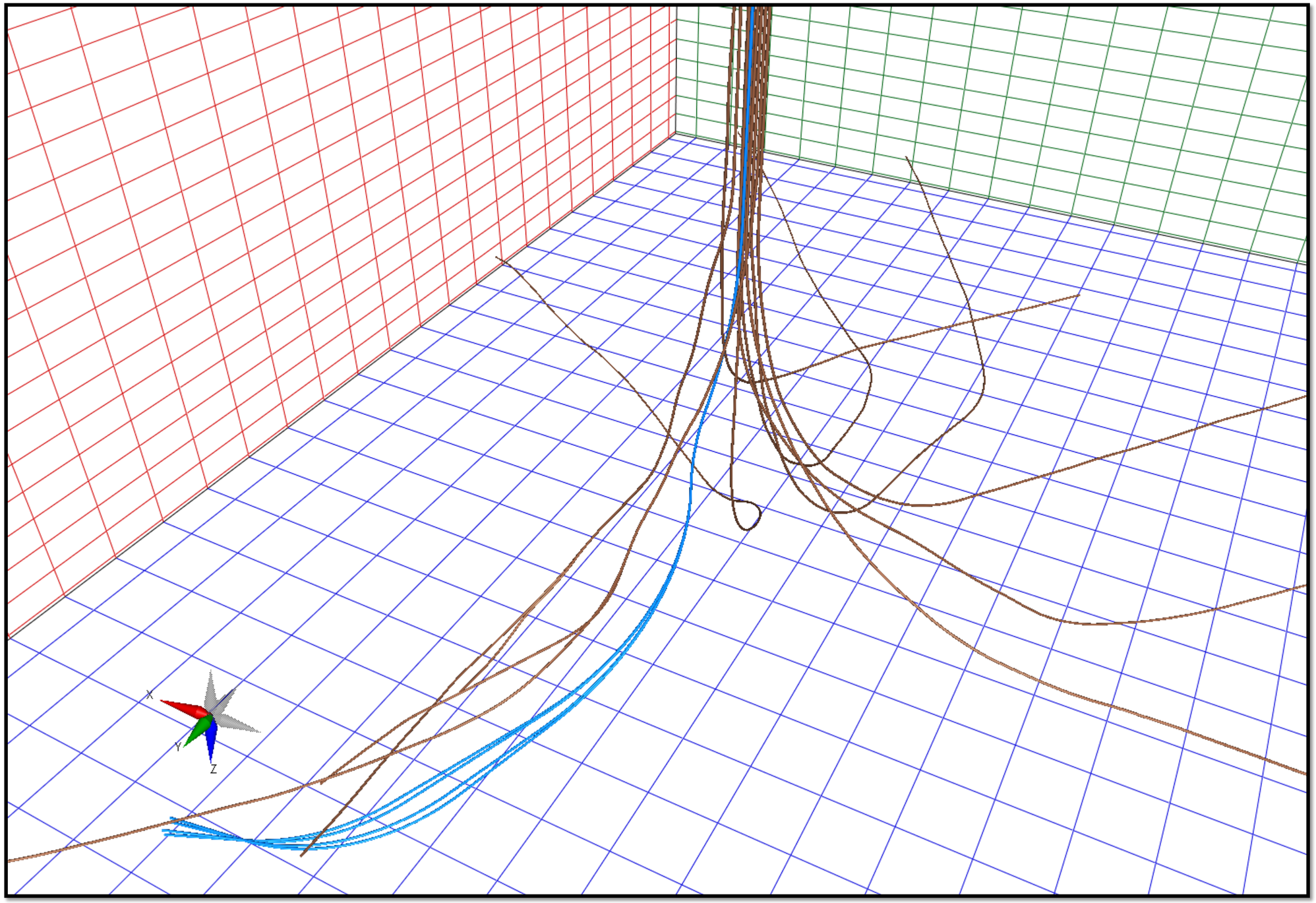


# Breaking out through the tangle of wells

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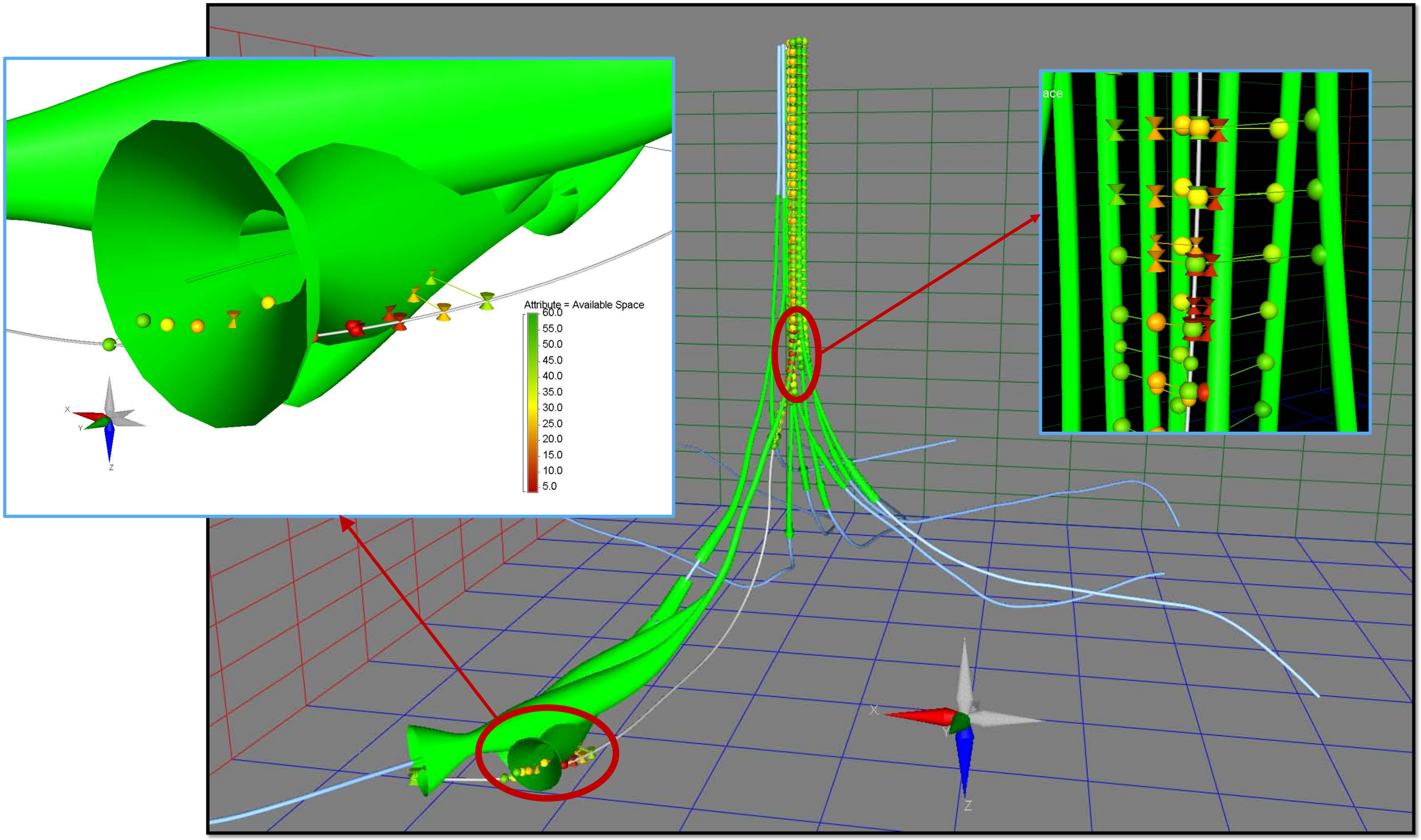
# Breaking out through the tangle of wells

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# Traditional Clearance Report – 1D “The Numbers”

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## Clearance Report

**Demo - initial 1000**
**Closest Approach**
Page 2 of 24

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| REFERENCE WELLPATH IDENTIFICATION | | | |
|---|---|---|---|
| Operator | **Aviemore** | Slot | **Demo** |
| Area | **Aviemore** | Well | **Demo well** |
| Field | **Aviemore** | Wellbore | **Demo wellbore** |
| Facility | **130/60A-D** | | |

| CALCULATION RANGE & CUTOFF | | |
|---|---|---|
| From: **0.00m MD** | To: **1000.00m MD** | C-C Cutoff: **(none)** |

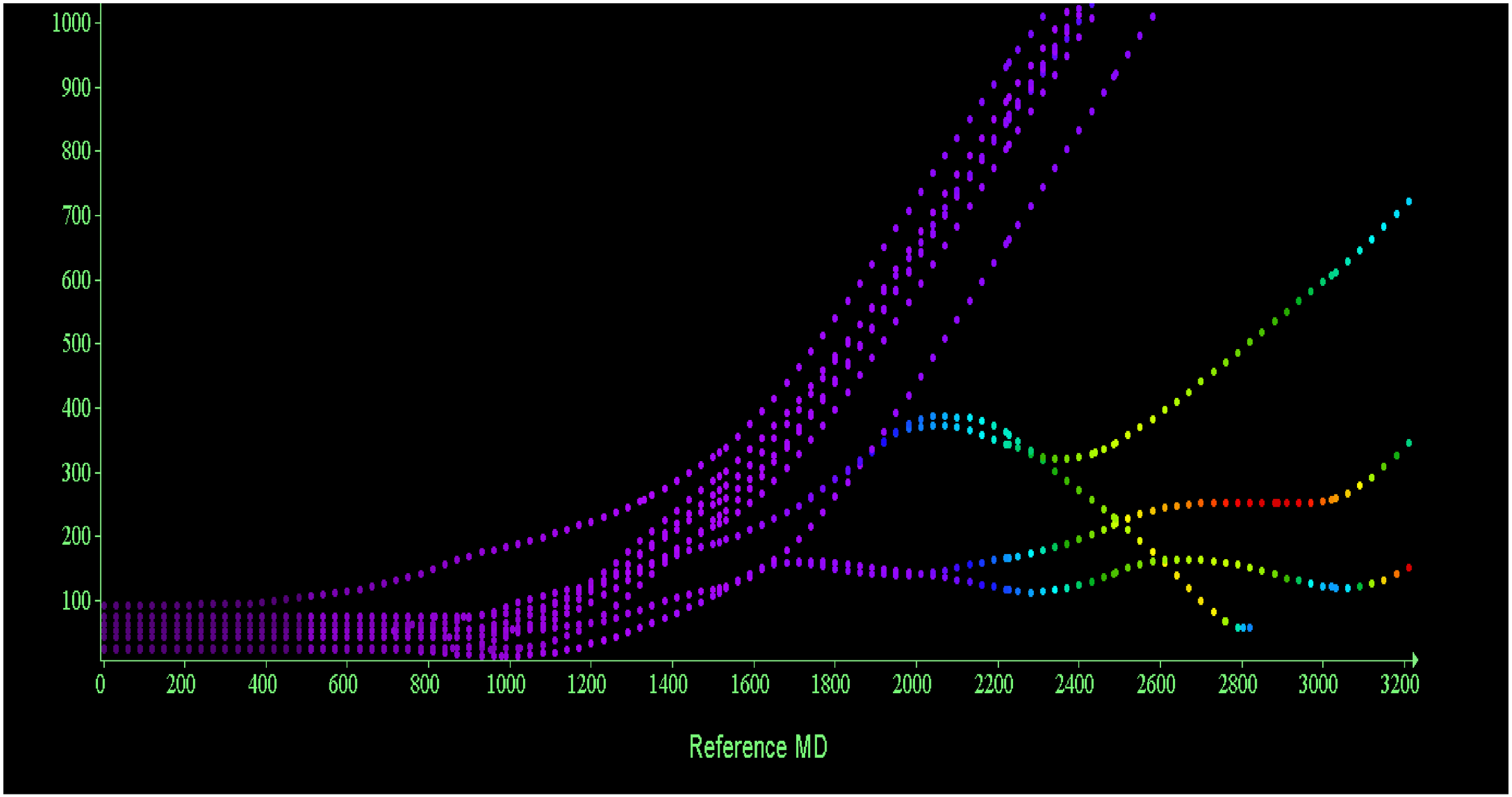
**OFFSET WELL CLEARANCE SUMMARY** (11 Offset Wellpaths selected)

| Offset Facility | Offset Slot | Offset Well | Offset Wellbore | Offset Wellpath | C-C Clearance Distance | | | ACR Separation Distance | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ref MD [m] | Min C-C Clear Dist [m] | Diverging from MD [m] | Ref MD of Min Sep Dist [m] | Min Sep Dist [m] | Min Sep Dist Dvrg From [m] | ACR Status |
| 130/60A-D | D04 | 130/60A-D04(P11) | 130/60A-D04 | 130/60A-D04 | 972.72 | 9.75 | 972.72 | 972.72 | 9.75 | 972.72 | FAIL |
| 130/60A-D | D04 | 130/60A-D04Z(P11) | 130/60A-D04Z | 130/60A-D04Z | 972.72 | 9.75 | 972.72 | 972.72 | 9.75 | 972.72 | FAIL |
| 130/60A-D | D02 | 130/60A-D02(P13) | 130/60A-D02 | 130/60A-D02 | 0.00 | 23.88 | 570.00 | 0.00 | 23.88 | 570.00 | FAIL |
| 130/60A-D | D08 | 130/60A-D08(P14) | 130/60A-D08 | 130/60A-D08 | 600.00 | 25.17 | 600.00 | 600.00 | 25.17 | 600.00 | FAIL |
| 130/60A-D | D07 | 130/60A-D07 | | | | | | | | | |
| 130/60A-D | D09 | 130/60A-D09 | | | | | | | | | |
| 130/60A-D | D01 | 130/60A-D01 | | | | | | | | | |
| 130/60A-D | D06 | 130/60A-D06 | | | | | | | | | |
| 130/60A-D | D06 | 130/60A-D06 | | | | | | | | | |
| 130/60A-D | D03 | 130/60A-D03 | | | | | | | | | |
| 130/60A-D | D05 | 130/60A-D05 | | | | | | | | | |



| Offset Wellpath | C-C Clearance Distance | | | ACR Separation Distance | | | |
|---|---|---|---|---|---|---|---|
| | Ref MD [m] | Min C-C Clear Dist [m] | Diverging from MD [m] | Ref MD of Min Sep Dist [m] | Min Sep Dist [m] | Min Sep Dist Dvrg From [m] | ACR Status |
| 130/60A-D04 | 972.72 | 9.75 | 972.72 | 972.72 | 9.75 | 972.72 | FAIL |
| 130/60A-D04Z | 972.72 | 9.75 | 972.72 | 972.72 | 9.75 | 972.72 | FAIL |

# 2D Representation of Report Numbers: Clearance Distance vs MD

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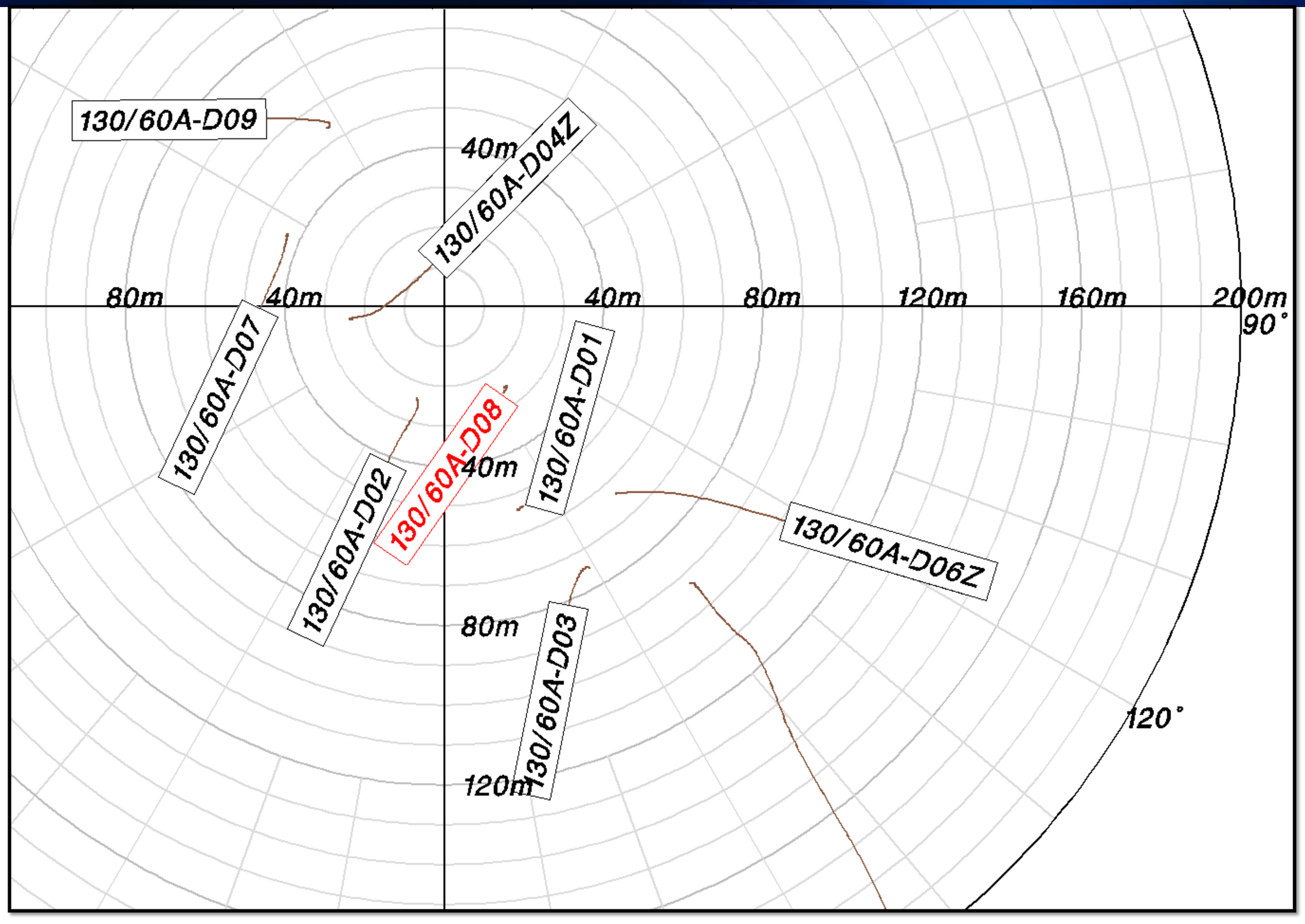
# Clearance Data on Traveling Cylinder Plot – 2D

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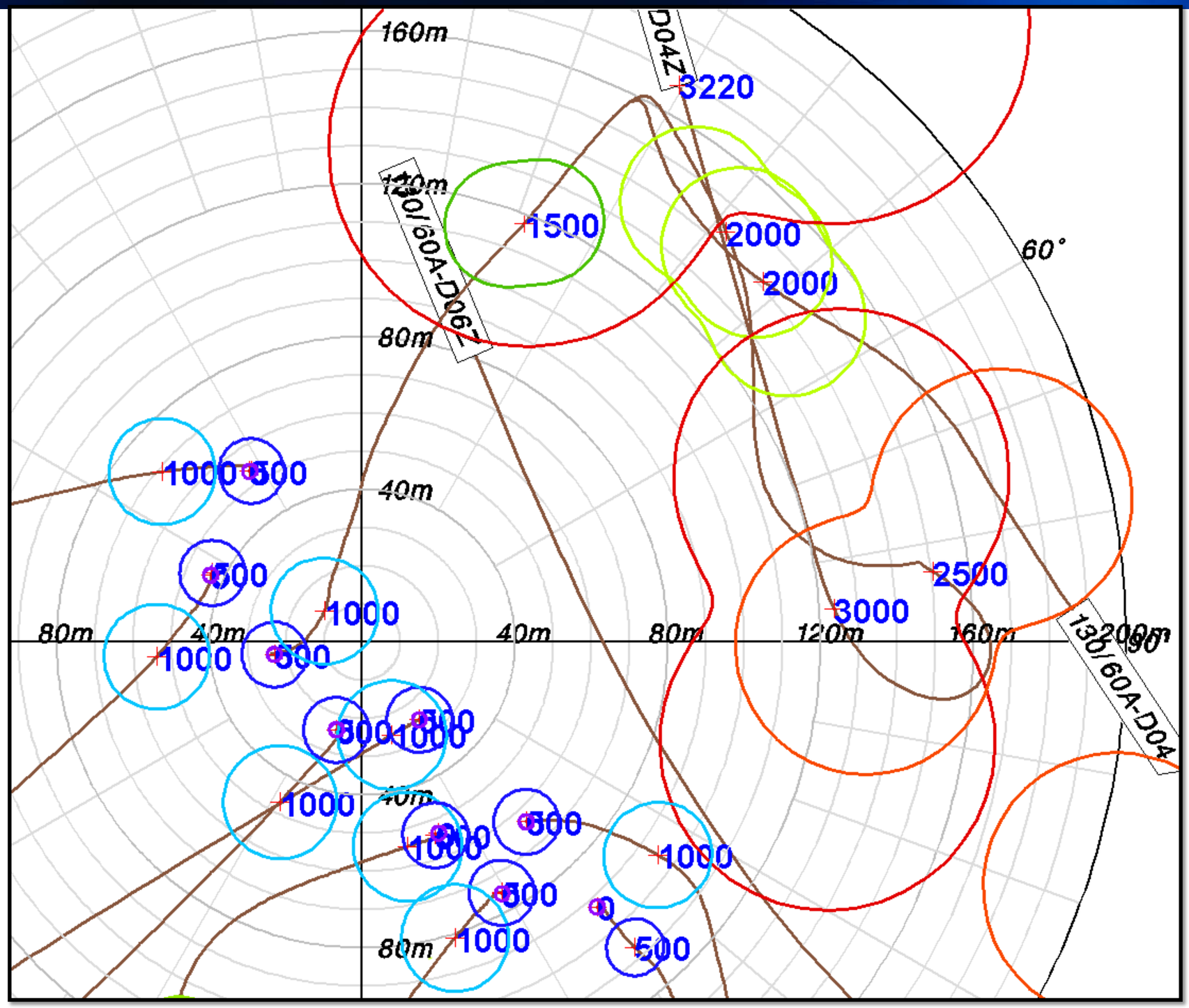
# Clearance Data on Traveling Cylinder Plot – 2D

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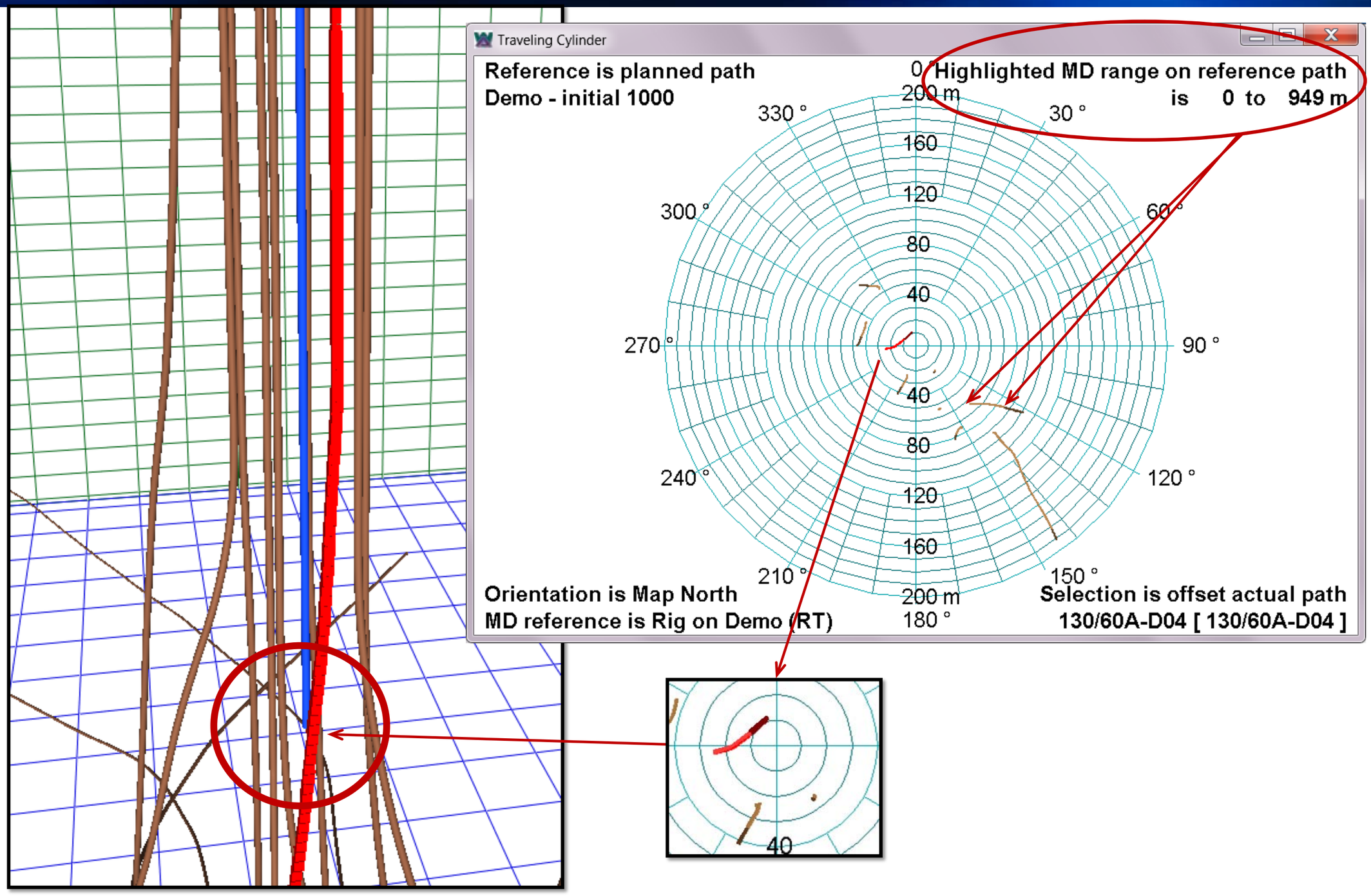
# Working with 2D representations with 3D

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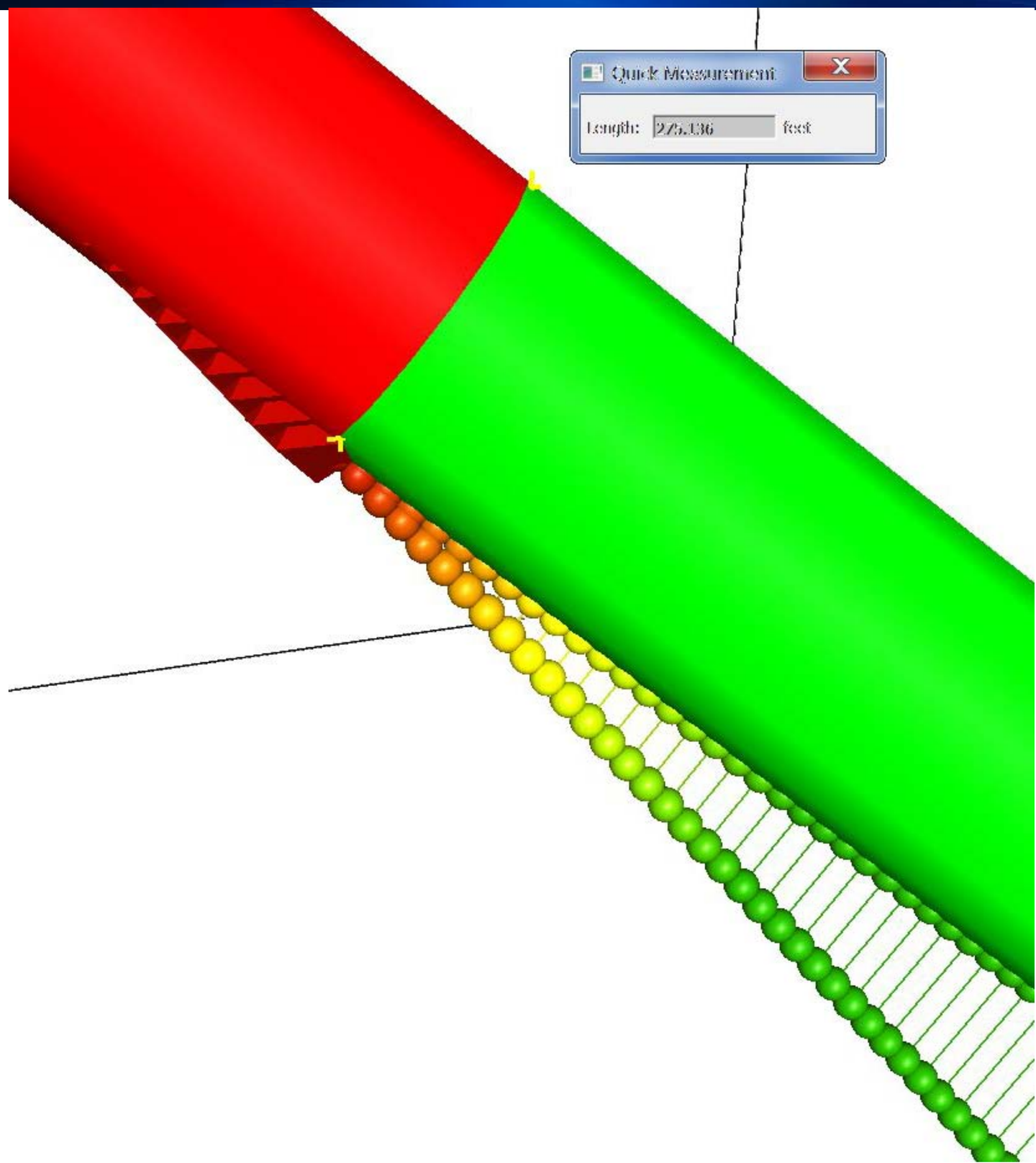
# Represent the Clearance Data in 3D

- Tube of “minimum allowable separation distance” (MASD)
- ACR Pass / fail coloring on tube
- Add new information: “Available space” symbol based on ACR
- Does not replace reports, TC plots, etc – rather enhances the process

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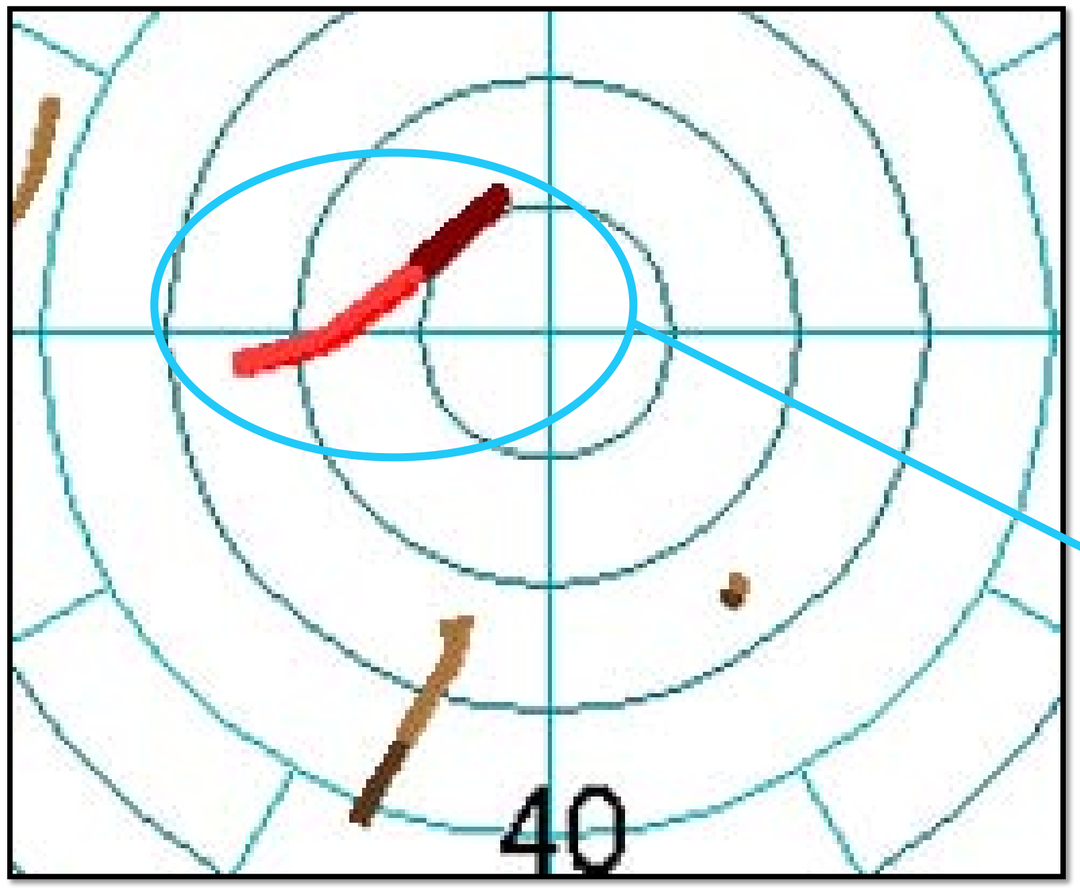
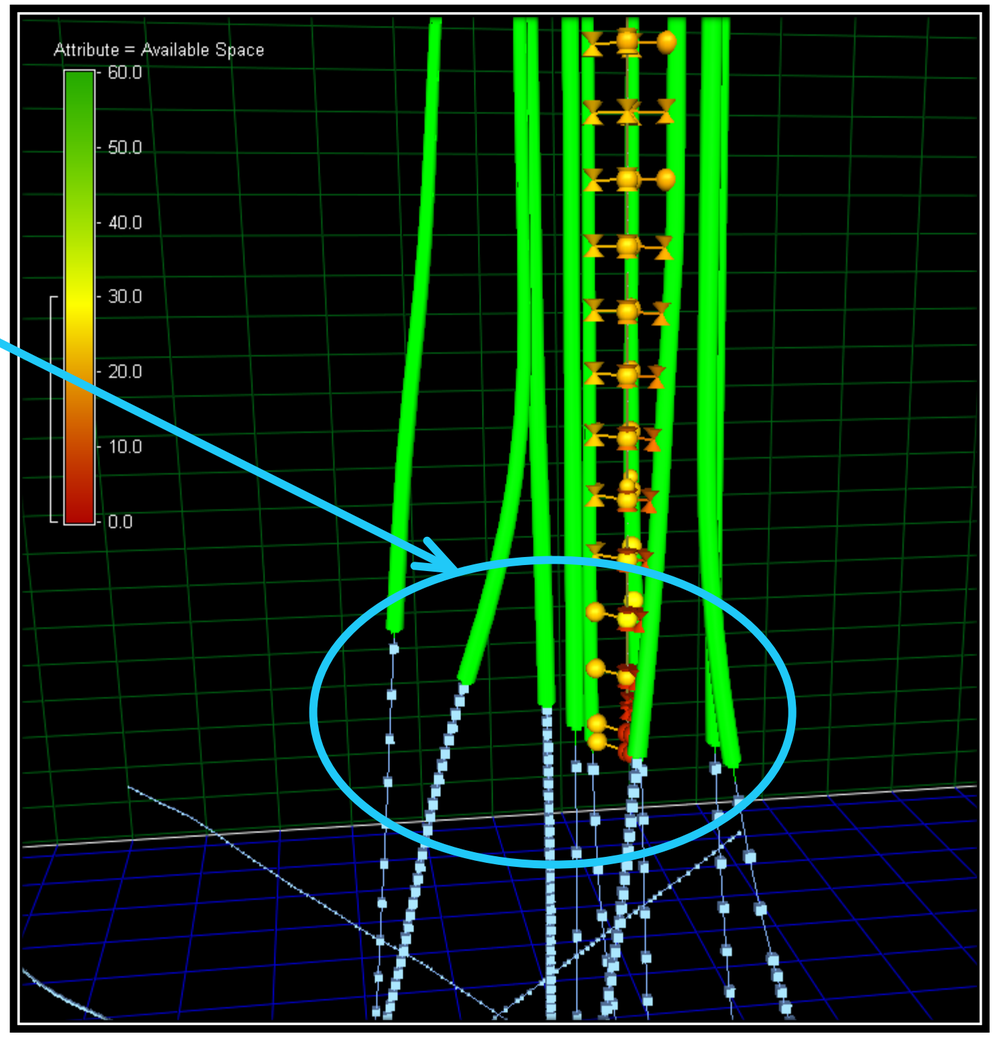
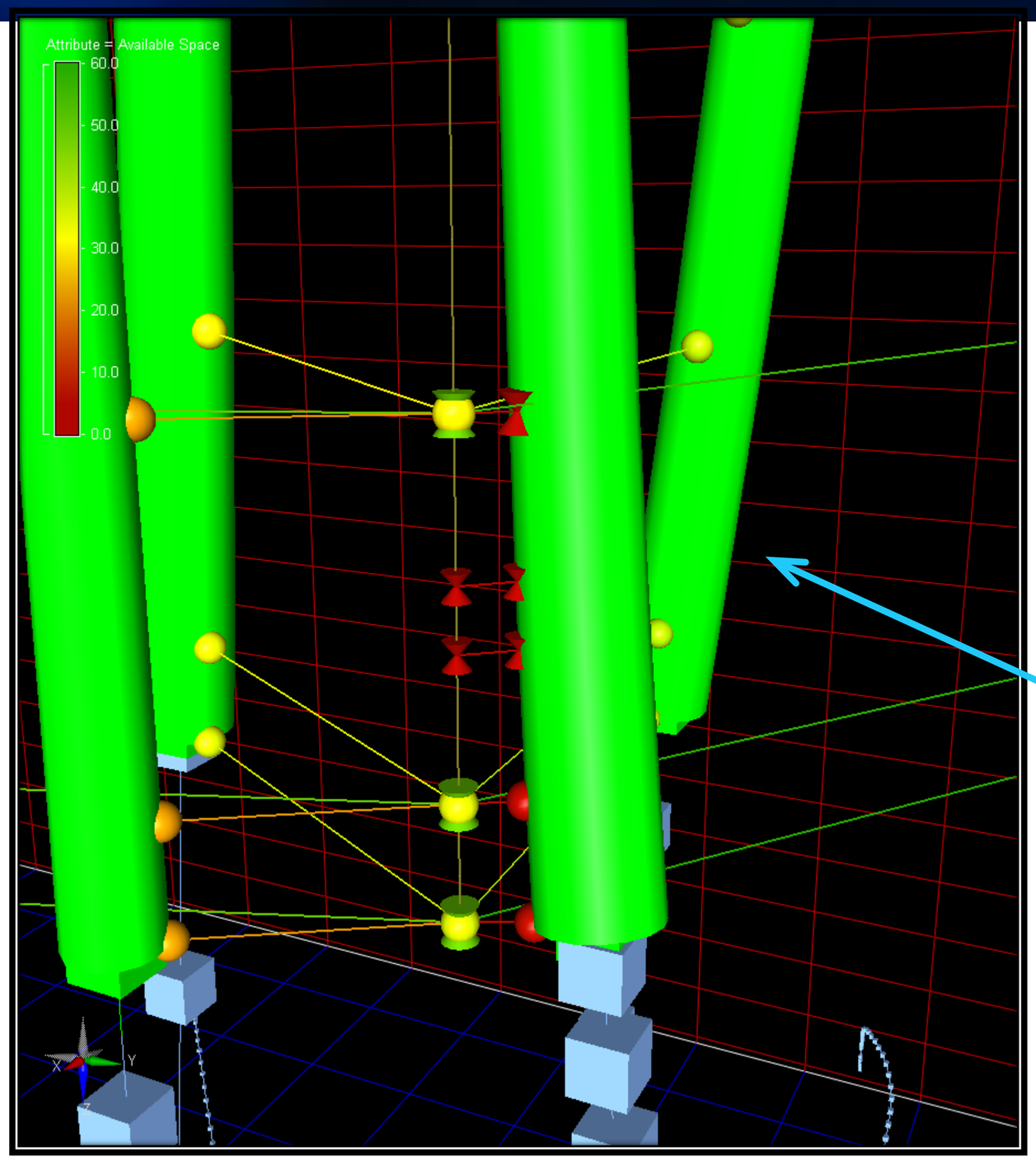
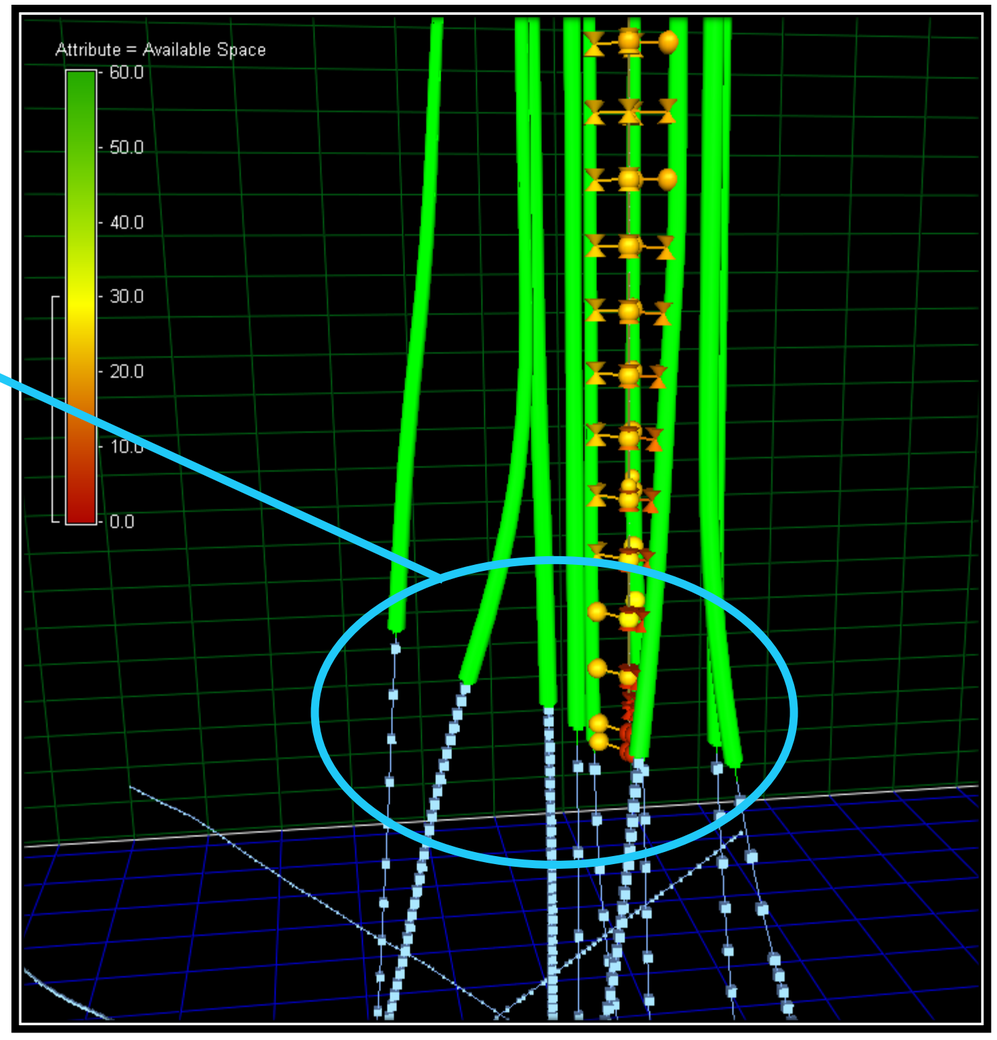
# Altering Path Based on Available Space



# Altering Path Based on Available Space

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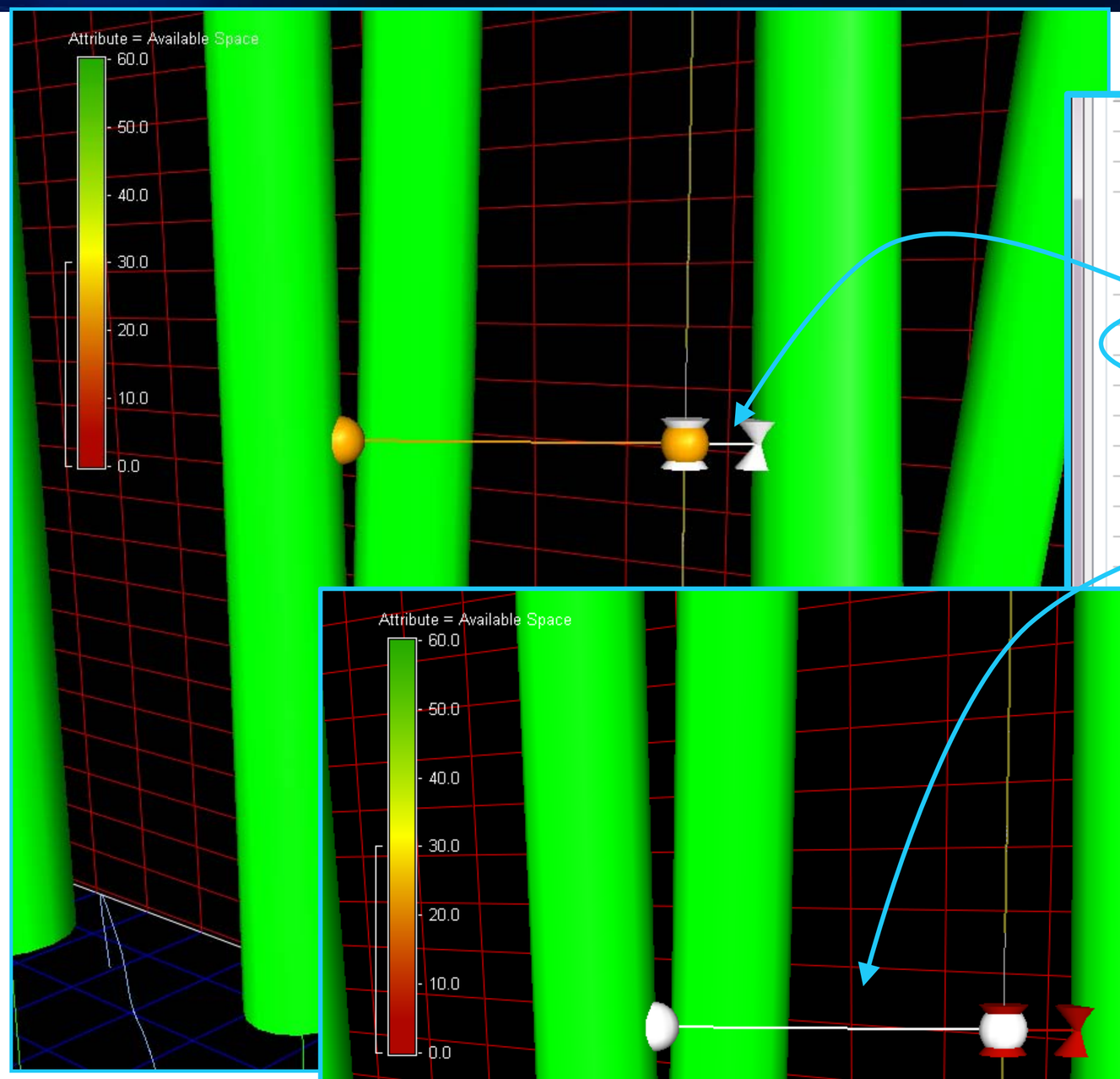
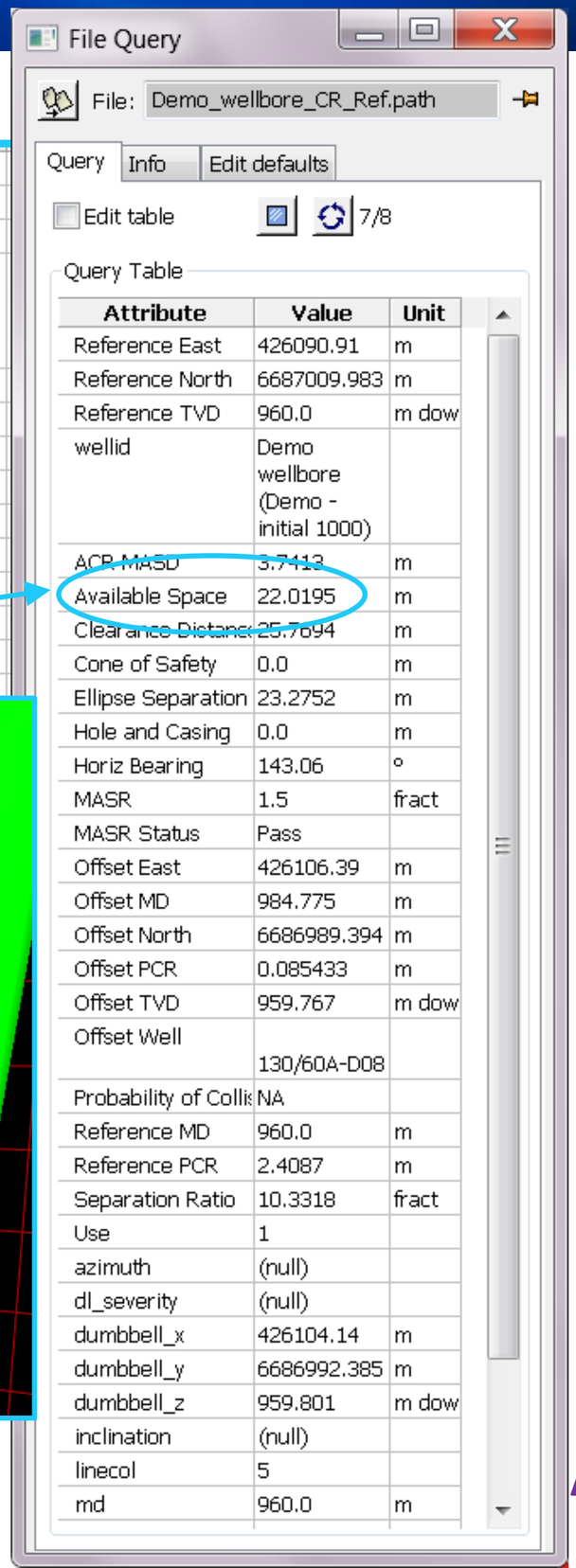
# Altering Path Based on Available Space







| | |
|---|---|
| Reference East | 426090.91 |
| Reference North | 6687009.983 |
| Reference TVD | 960.0 |
| wellid | Demo wellbore (Demo - initial 1000) |
| ACR MASD | 4.8145 |
| Available Space | 5.1868 |
| Clearance Distance | 10.0047 |
| Cone of Safety | 0.0 |
| Ellipse Separation | 6.795 |
| Hole and Casing | 0.0 |
| Horiz Bearing | 305.248 |
| MASR | 1.5 |
| MASR Status | Pass |
| Offset East | 426082.74 |




| Attribute | Value | Unit |
|---|---|---|
| Reference East | 426090.91 | m |
| Reference North | 6687009.983 | m |
| Reference TVD | 960.0 | m dow |
| wellid | Demo wellbore (Demo - initial 1000) | |
| ACR MASD | 3.7413 | m |
| Available Space | 22.0195 | m |
| Clearance Distance | 25.7694 | m |
| Cone of Safety | 0.0 | m |
| Ellipse Separation | 23.2752 | m |
| Hole and Casing | 0.0 | m |
| Horiz Bearing | 143.06 | ° |
| MASR | 1.5 | fract |
| MASR Status | Pass | |
| Offset East | 426106.39 | m |
| Offset MD | 984.775 | m |
| Offset North | 6686989.394 | m |
| Offset PCR | 0.085433 | m |
| Offset TVD | 959.767 | m dow |
| Offset Well | 130/60A-D08 | |
| Probability of Collis | NA | |
| Reference MD | 960.0 | m |
| Reference PCR | 2.4087 | m |
| Separation Ratio | 10.3318 | fract |
| Use | 1 | |
| azimuth | (null) | |
| dl_severity | (null) | |
| dumbbell_x | 426104.14 | m |
| dumbbell_y | 6686992.385 | m |
| dumbbell_z | 959.801 | m dow |
| inclination | (null) | |
| linecol | 5 | |
| md | 960.0 | m |

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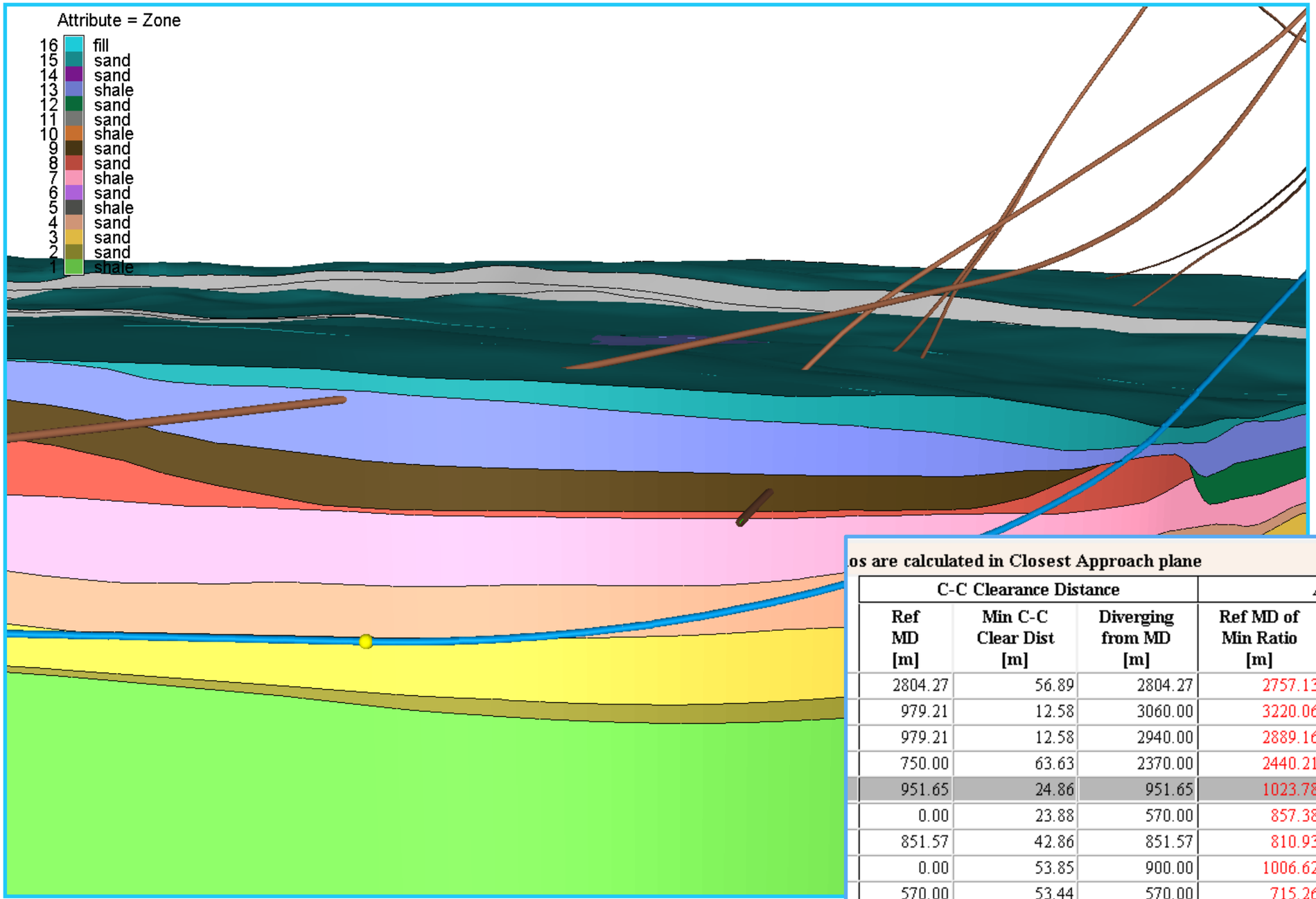
**Analyze.**

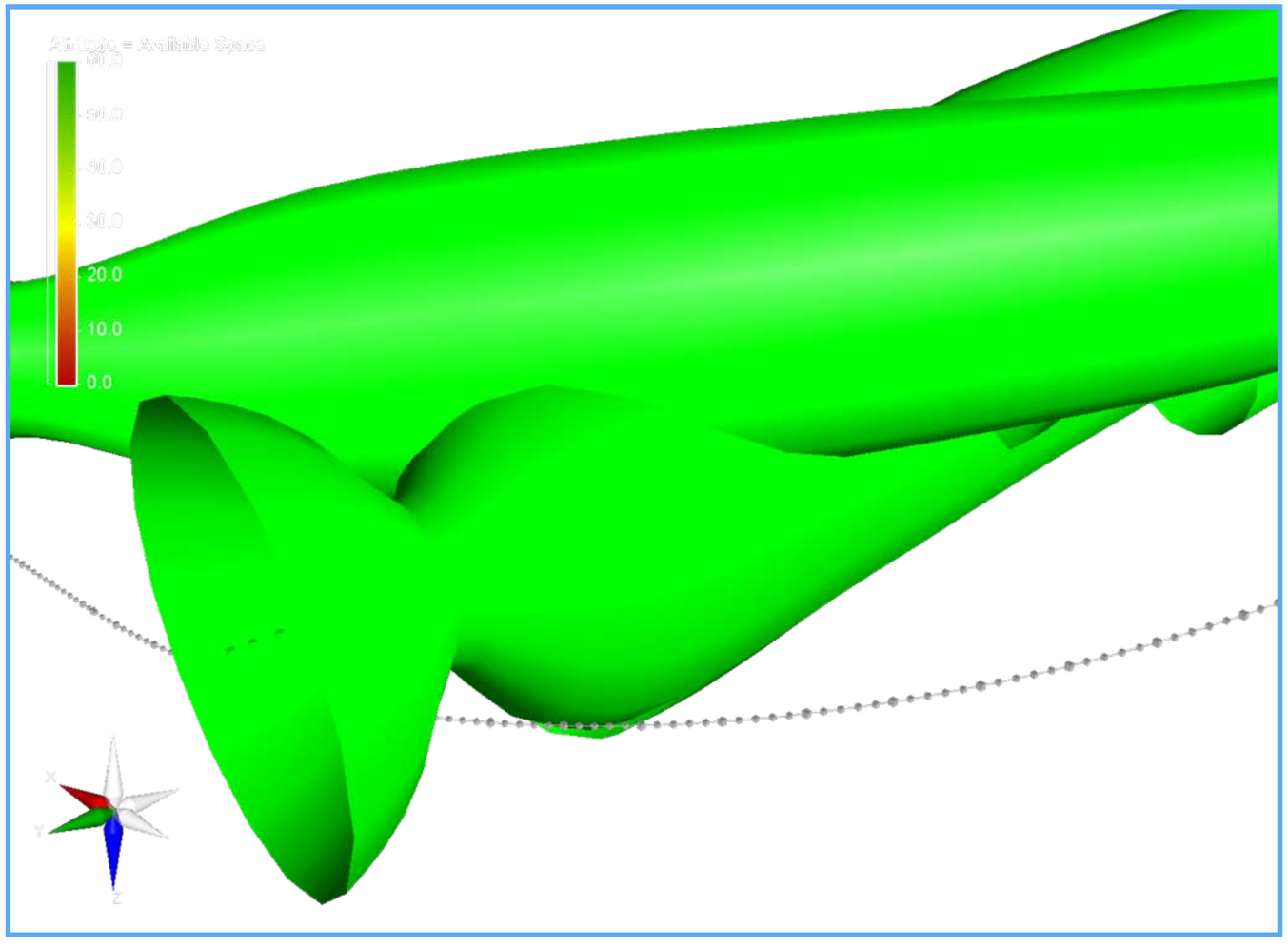
# Report and 3D Viewing May Not Be Enough

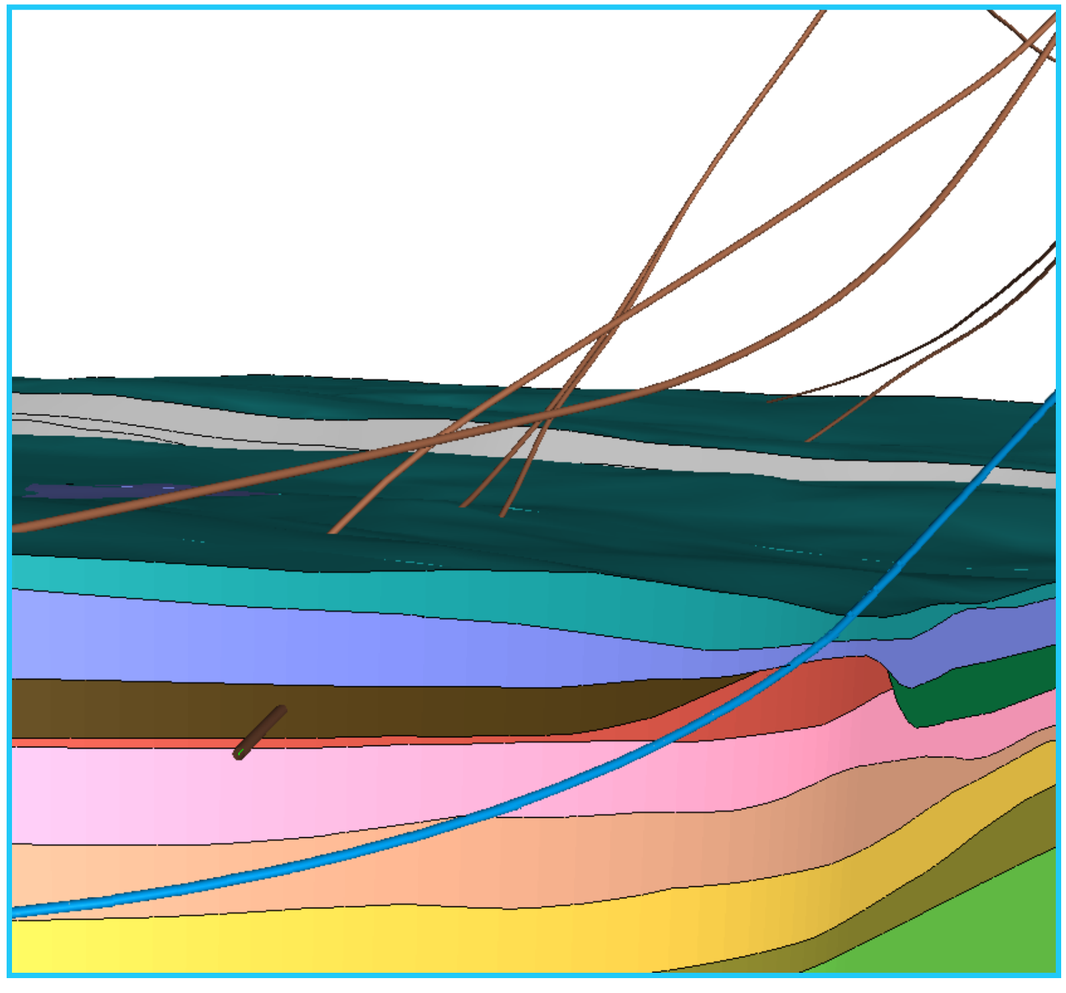



os are calculated in Closest Approach plane

| C-C Clearance Distance | | | ACR Separation Ratio | | | |
|---|---|---|---|---|---|---|
| Ref MD [m] | Min C-C Clear Dist [m] | Diverging from MD [m] | Ref MD of Min Ratio [m] | Min Ratio | Min Ratio Dvrg from [m] | ACR Status |
| 2804.27 | 56.89 | 2804.27 | 2757.13 | 1.59 | 2880.00 | PASS |
| 979.21 | 12.58 | 3060.00 | 3220.06 | 2.17 | 3220.06 | PASS |
| 979.21 | 12.58 | 2940.00 | 2889.16 | 3.67 | 2889.16 | PASS |
| 750.00 | 63.63 | 2370.00 | 2440.21 | 7.49 | 2440.21 | PASS |
| 951.65 | 24.86 | 951.65 | 1023.78 | 9.42 | 3220.06 | PASS |
| 0.00 | 23.88 | 570.00 | 857.38 | 9.88 | 3220.06 | PASS |
| 851.57 | 42.86 | 851.57 | 810.93 | 14.30 | 3220.06 | PASS |
| 0.00 | 53.85 | 900.00 | 1006.62 | 15.99 | 3220.06 | PASS |
| 570.00 | 53.44 | 570.00 | 715.26 | 17.18 | 810.00 | PASS |
| 810.00 | 74.50 | 814.59 | 885.13 | 23.41 | 3220.06 | PASS |
| 0.00 | 92.65 | 210.00 | 1329.87 | 45.62 | 3220.06 | PASS |

# Viewing in 3D Shows How Relative Ellipsoid Angle Affects MASD – Pronounced Thinning



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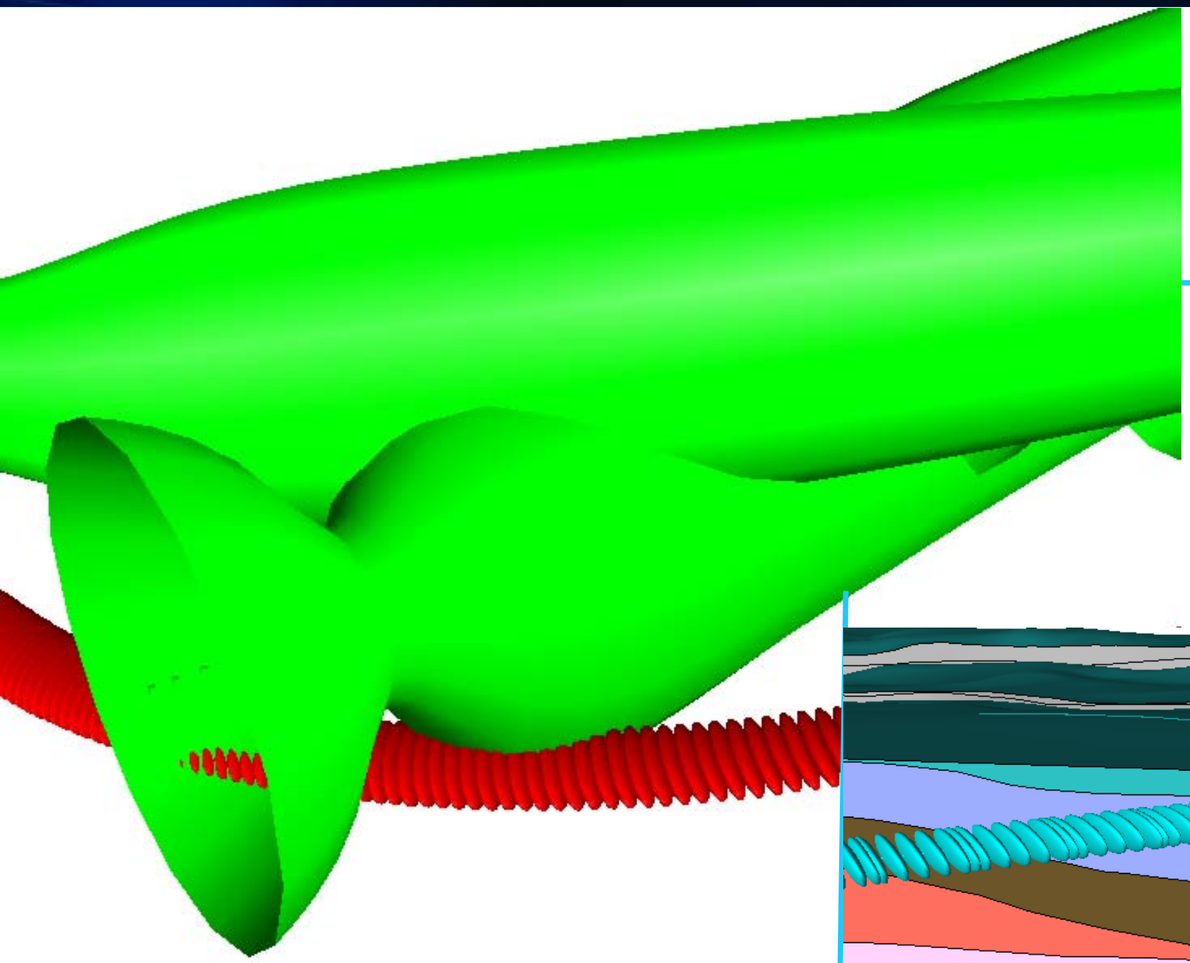

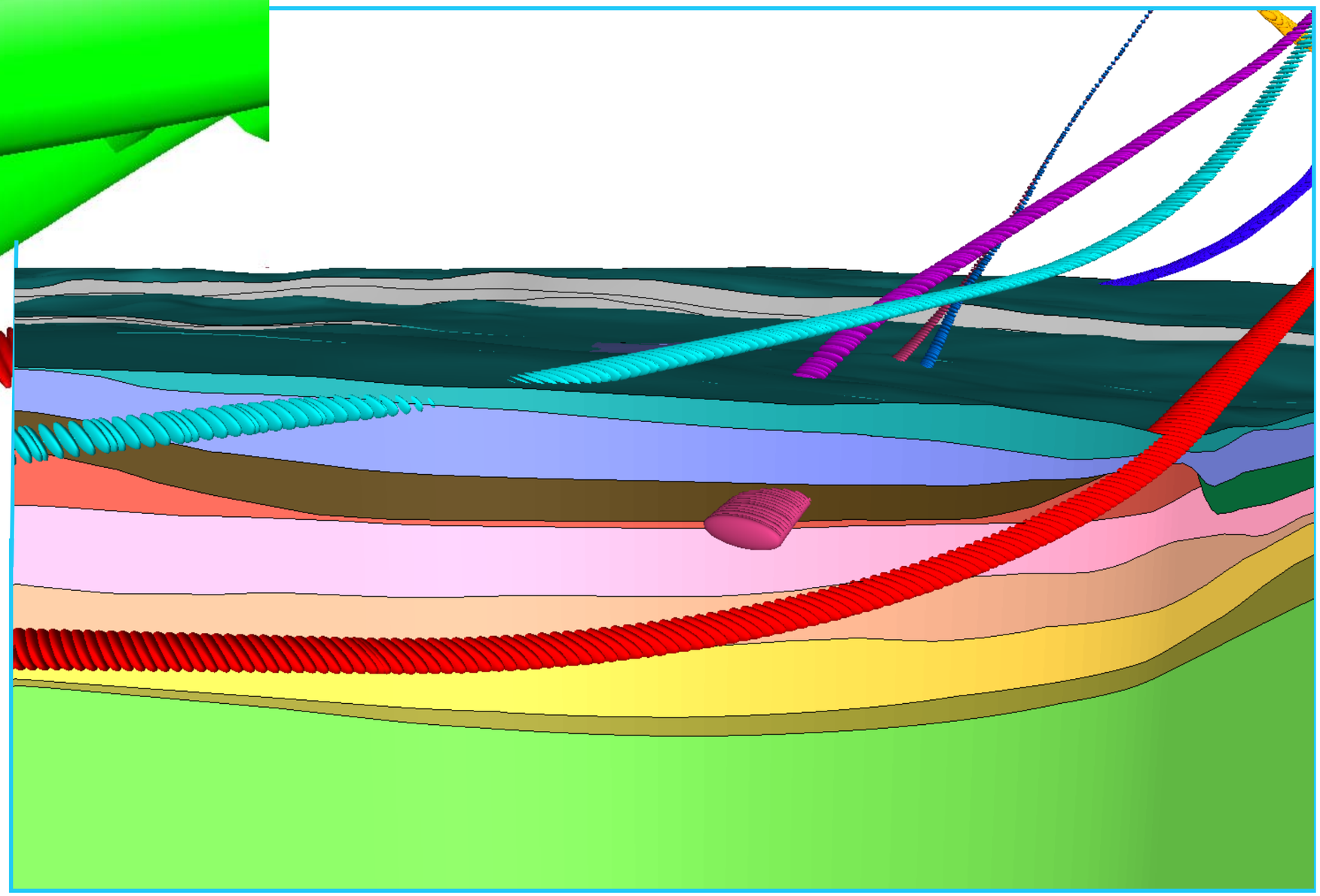

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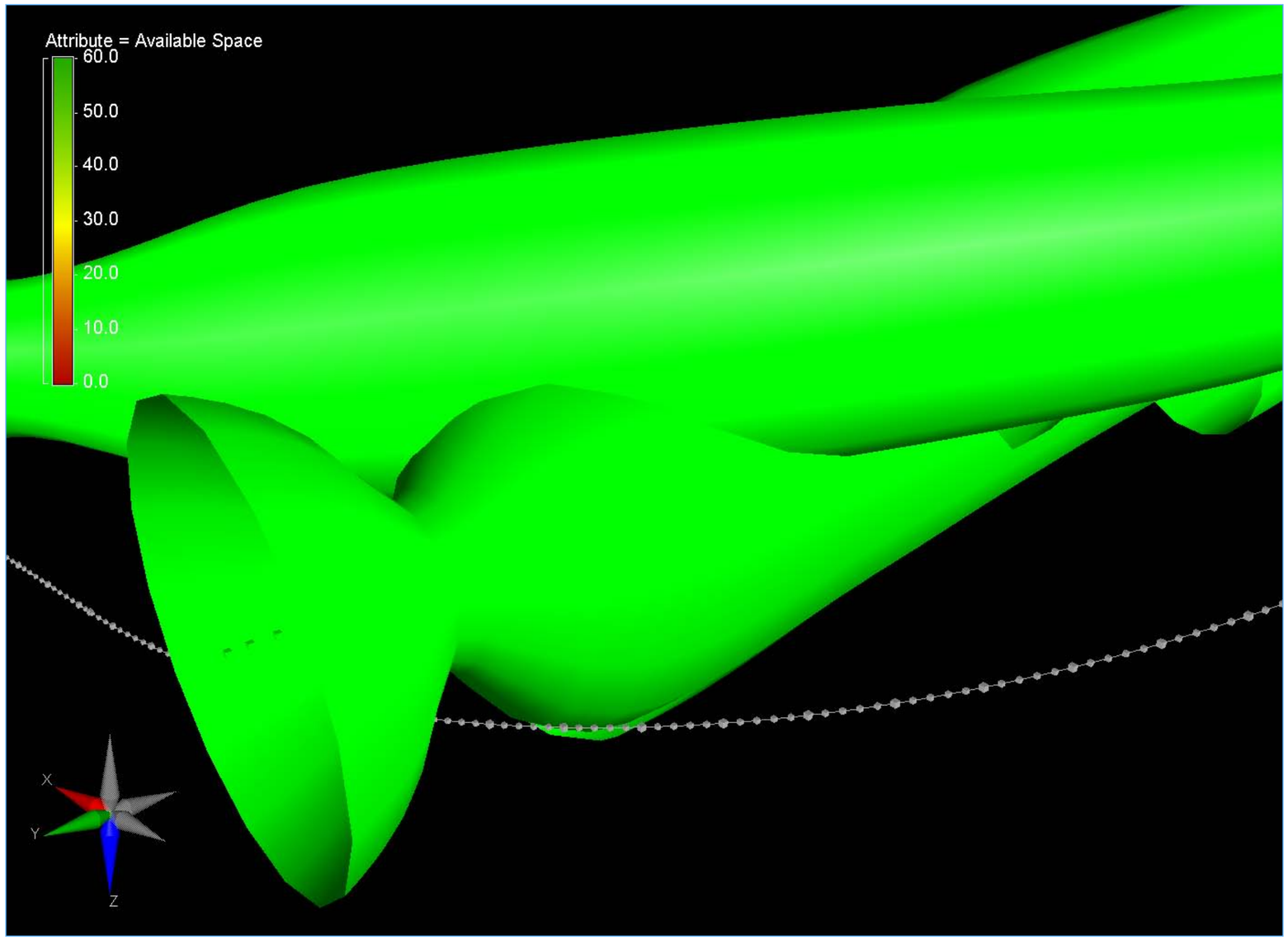
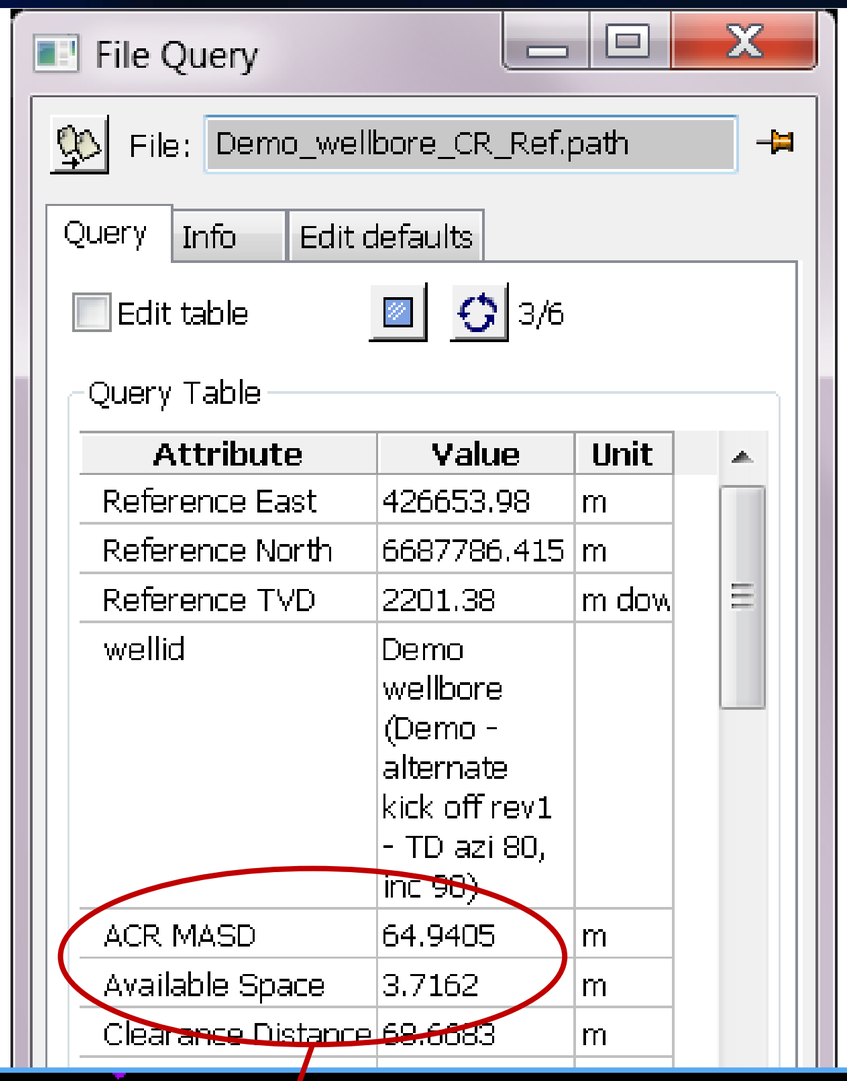
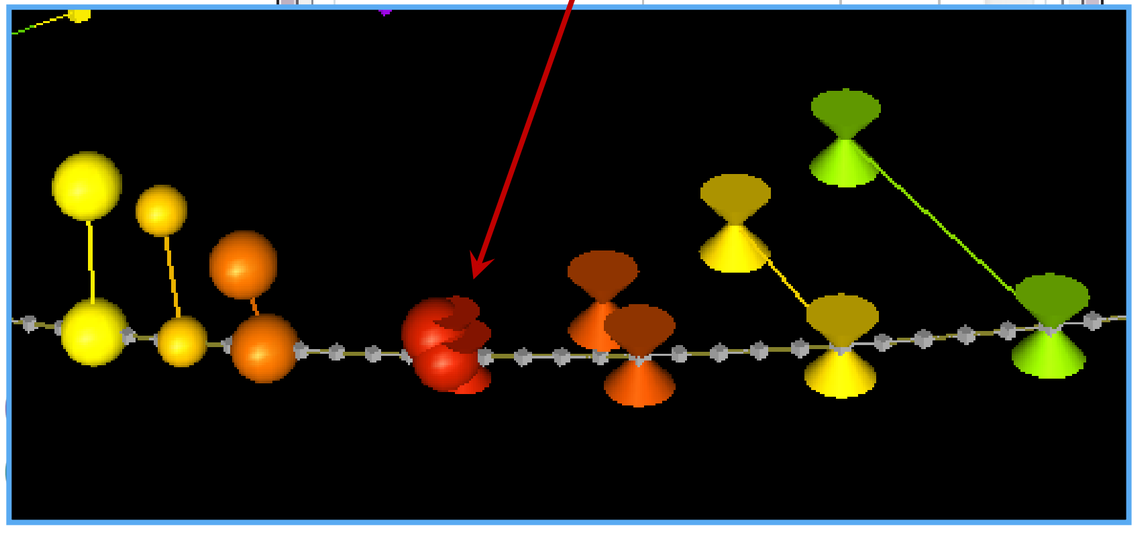
# Adding Tubes with Radius = MASD / Available Space



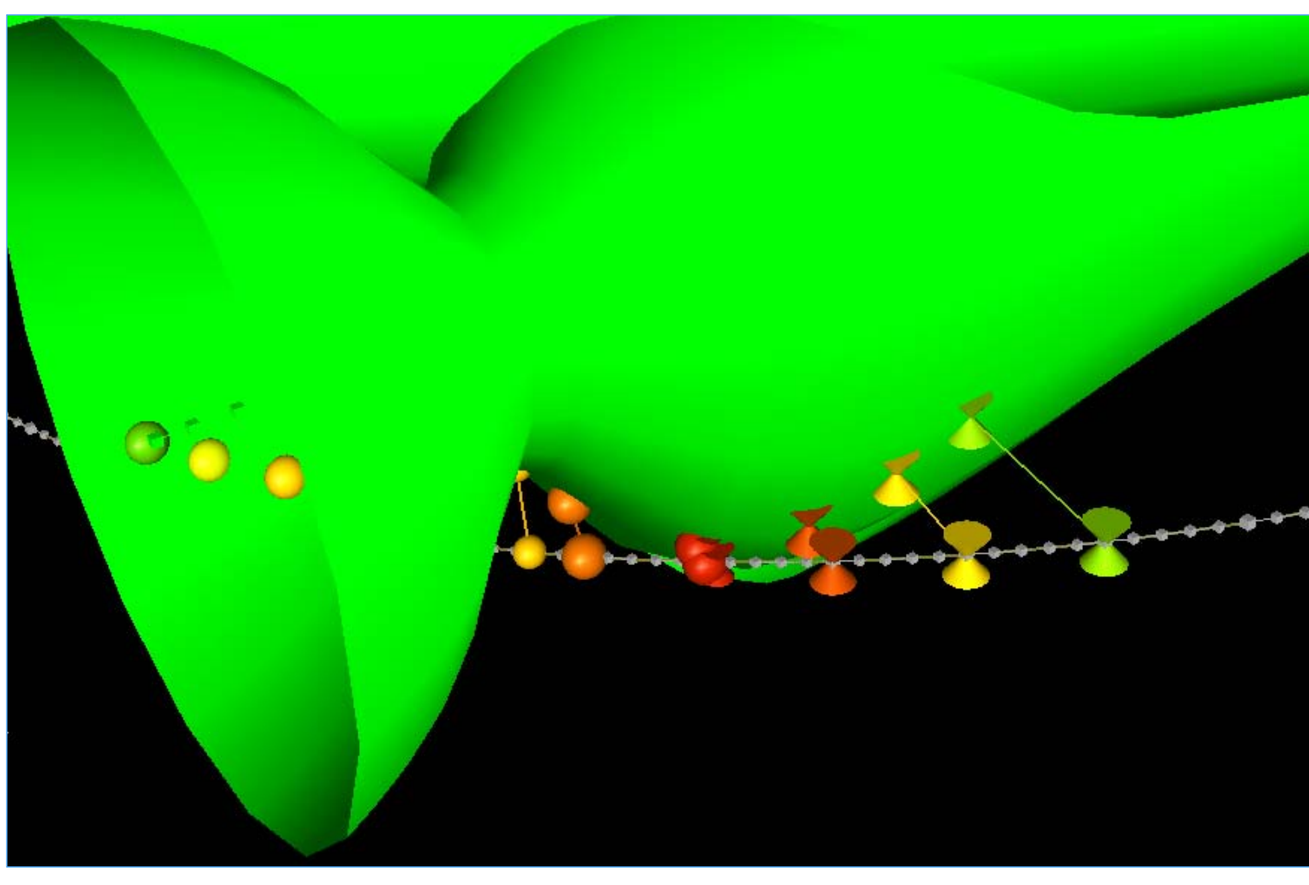

- Report shows we passed the ACR
- Green = Pass

# Adding Tubes with Radius = MASD / Available Space



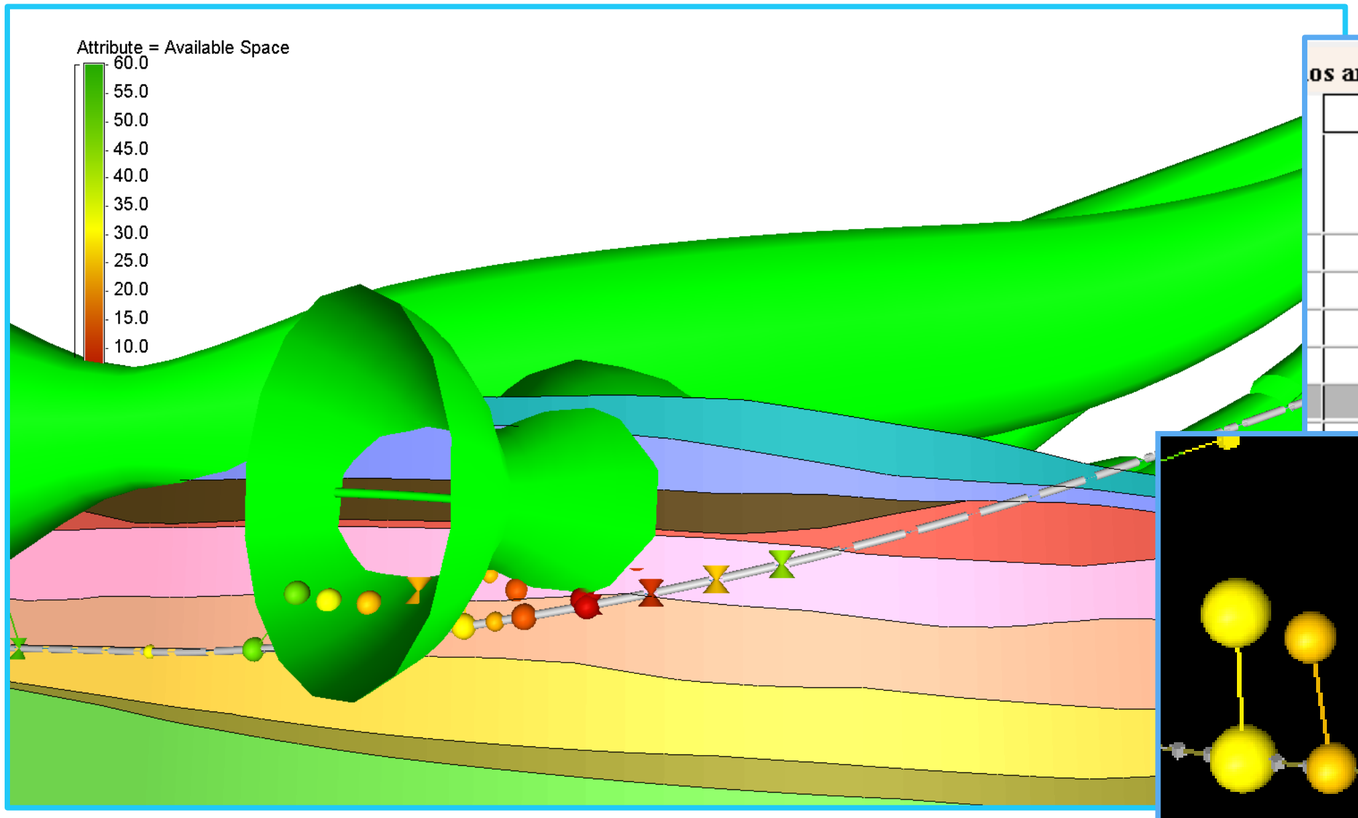



- But Available Space shows a more informative story
- …which we can then correct quickly



# Conclusions

- We have the numbers, but what's full extent of their meaning?
- 2D tools are excellent at telling us something is wrong
- By finding ways to bring the 2D information into 3D, we can have a better understanding of the full context of the issues
- Plus we quickly evaluate a wider range of options, leading to better, safer wells




os are calculated in Closest Approach plane

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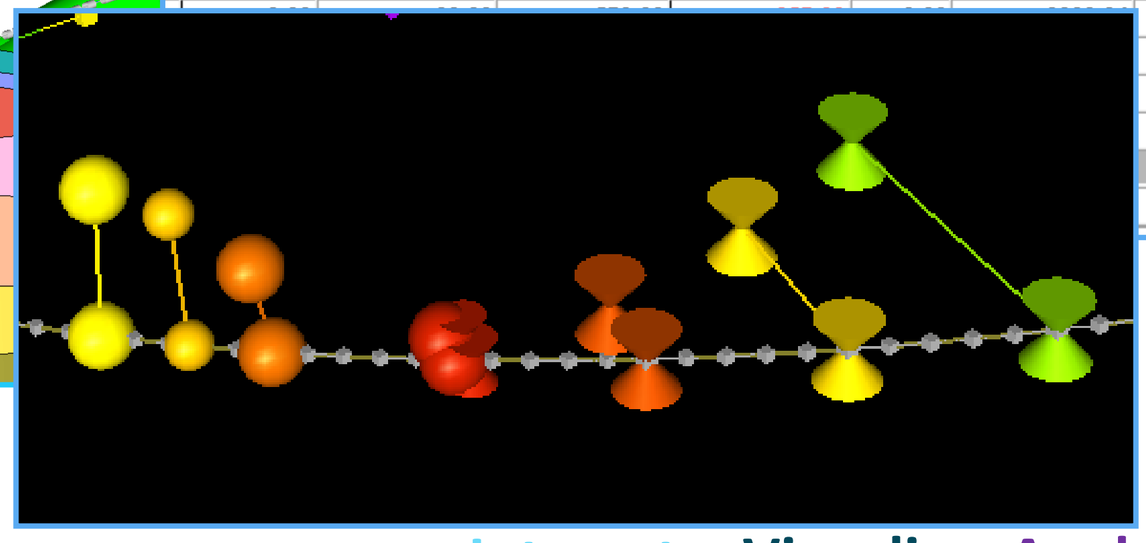
| 951.65 | 24.86 | 951.65 | 1023.78 | 9.42 | 3220.06 | PASS |
| | | | | | | PASS |
| | | | | | | PASS |
| | | | | | | PASS |
| | | | | | | PASS |
| | | | | | | PASS |
| | | | | | | PASS |



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# Acknowledgements


- Andy Sentance, Dynamic Graphics

- Gary Skinner, Gregory Forde, and Baker Hughes

*And to the ISCWSA and the audience, thank you....*


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